RamFactor™

User's Manual

AE APPLIED ENGINEERING™

A DIVISION OF AE RESEARCH CORPORATION

v1.5

Table of Contents

Preface

Before you begin... **iii**

Please read this

About This Manual... iii

Comments? iv

1

Getting Started 1

Introduction 1

About RamFactor 1

RamFactor Installation 2

Into the Computer 3

2

AppleWorks Expander™ *5*

About the AppleWorks Expander disk *5*

What You Will Need 6

Important Notes 7

AppleWorks Expander Instructions 8

About the New Features 12

3

AppleWorks for the Apple][Plus 19

Introduction 19

About the AppleWorks Expander... 19

Software Required 20

Minimum Hardware Required 20

Optional Hardware 20

Enhancing AppleWorks 20

Alternate AppleWorks Keyboard Commands 21

Lower Case Characters 21

Optional Shift Key Hardware Modification 22

4

Putting RamFactor to Work 23

Introduction 23

ProDOS RAMdisk 23

AutoCopy Instructions 25

DOS 3.3 RAMdisk 28

Copying Files to DOS 3.3 RAMdisk 29

Pascal 1.3 RAMdisk 31

CP/AM 5.1 RAMdisk 32

5

33

RamFactor Partition Manager

About the Partition Manager 33
Accessing the Partition Manager 33
Selecting a RAMdisk Partition 34
Configuring Partitions 34
Booting a Partition 37
Changing Partitions 37

6

RamFactor Technical Reference **39**

Introduction 39
Adding Memory to RamFactor 39
Memory Chip Installation 40
RamFactor Diagnostic Program 41
Description of RamFactor 41
RamFactor Partition Manager Firmware 41
Using ProDOS 43
Using Pascal 1.3 43
Using DOS 3.3 43
Operating System Identification 44
RamFactor Hardware 45
Finding the RamFactor Card 45
Finding RamFactor's Size 46
Protocol Converter 48

Appendices

A

RamFactor Battery Backup Option **53**

B

RamFactor Memory Test **54**

C

Copying Disks with Filer **55**

D

Applied Engineering Technical Support **56**

E

For More Information... **57**

Before You Begin...

PLEASE read this...

Using RamFactor is not difficult. You don't have to be a programmer or computer whiz, but you must have a basic understanding of the overall operation of your computer system. Learning several new things at one time can be very frustrating, so before jumping into this manual, please read the owner's manual that came with your computer and become familiar with any software you wish to use with RamFactor. Everything you need to know about using RamFactor should be in this manual. We ask you to read it carefully and thoroughly. For additional sources of information, please refer to Appendix B.

About This Manual...

This manual is included with the Applied Engineering RamFactor peripheral accessory card. It explains what RamFactor is, how it can enhance the performance of your software and computer system, and how to install and use it. How you intend to use RamFactor will determine which chapters you need to read. Use the chapter summary, below, to decide which chapters are applicable to your needs.

Chapter 1: ***Getting Started*** provides an overview of RamFactor and the instructions for installing it in your computer.

Chapter 2: ***AppleWorks Expander*** tells you how to use RamFactor and the AppleWorks Expander disk to enhance the performance of AppleWorks.

Chapter 3: ***AppleWorks for the Apple*][*Plus*** is intended for owners of Apple] [Plus computers and those who want to enhance AppleWorks V1.2 or 1.3 for use with a //e or IIGS. It covers the modifications required to allow AppleWorks to run on the Apple II Plus and the enhancements gained from the] [Plus modification.

Chapter *4:* ***Putting RamFactor to Work*** explains how to use RamFactor as a RAMdisk, a solid state disk drive.

Chapter *5:* ***RamFactor Partition Manager*** tells you how to divide RamFactor's memory into separate work areas, or partitions.

Chapter *6:* ***RamFactor Technical Reference*** tells you how to install additional memory chips on your RamFactor card and contains information about using the RamFactor

diagnostic program. This chapter also contains technical information required only by hard-core programmers.

Appendix A: ***RamCharger*** gives a brief overview of the RamCharger™ Battery Backup Option available for RamFactor.

Appendix B: ***RamFactor Memory Test*** instructs you on how to run the test included on the AW 2 Expander disk to check the basic operation and hardware reliability of your RamFactor card.

Appendix C: ***Copying disks with Filer*** gives you step by step instructions on how to use the Filer utility program to make backup copies of your disks.

Appendix D: ***Applied Engineering Technical Support*** provides you with information on what to do if things go wrong.

Appendix E: ***For More Information*** is a list of recommended books on topics related to your computer's hardware and software.

Comments?

We have tried to make this manual as informative, understandable, and error-free as possible. If you have any comments or suggestions regarding this manual or any other manual, we would be glad to here from you.

Please address any comments or suggestions to:

Applied Engineering
P.O. Box 798
Carroliton, Texas 75006
Attention: Manager, Technical Publications

1: Getting Started

Introduction

This chapter does just what its title says, it gets you started. It provides a brief introduction to RamFactor, tells you what you need to install the RamFactor card in your computer, and then gives you the step by step installation instructions. Please take a few moments to read this chapter thoroughly before attempting the installation. The RamFactor card and its many features are covered in greater detail later in the manual.

About RamFactor

RamFactor is a plug-in accessory card which expands the Random Access Memory (RAM) capacity of your Apple][, Apple][Plus, or Apple lle personal computer. But, it is more than just a memory expansion card! The RAM on the RamFactor card expands the computer's storage capacity by emulating a solid state disk drive, or RAMdisk. In other words, the computer recognizes the RamFactor card as a peripheral device, a disk drive, not as just more memory.

Special programs, permanently stored on the RamFactor card (computer jargon: "firmware"), allow you to separate RamFactor's memory into individual ProDOS, DOS 3.3, CP/AM 5.1, and Pascal 1.3 work areas, or "partitions." This allows you to very quickly exit from one program (or operating system) and boot into another by simply selecting a menu option. And without changing a single disk!

Although RamFactor's expanded memory normally functions as a RAMdisk, it can also be used to enhance the performance of certain application programs specially written to take advantage of its extra RAM. For example, AppleWorks 1.3 uses the memory to expand its Desktop space.

What is a RAMdisk?

A conventional (mechanical) floppy or hard disk is a peripheral mass storage device capable of storing information on a recording medium, usually a magnetic disk. A RAMdisk uses Random Access Memory to emulate such a peripheral device. The conventional disk drive uses many moving mechanical parts to store and retrieve it recorded information. Since the RAMdisk has no moving parts, it can read and write files as fast as the computer. Some larger disk-intensive programs, such as AppleWorks, when loaded to and executed from a RAMdisk, run appreciably faster.

RamFactor Installation

This section tells you everything you need to know about installing RamFactor in your computer. Here are some important points about RamFactor's hardware requirements:

RamFactor can be installed in an Apple IIGS, //e (standard or enhanced),][Plus, Laser 128, or Franklin computer. (It cannot be installed in the Apple //c, the //c has no slots.)

RamFactor does not function as an 80 column text card. If you wish to run software written for 80 column display, you must have an 80 column card installed in your computer.

◊ The Apple //e requires an 80 column text card or extended 80 column text card installed in its auxiliary slot. Of course, an Applied Engineering RamWorks® auxiliary memory expansion/80 column card is recommended!

◊ Apple II, Apple][Plus, and Franklin Ace 1000 series computers require an Applied Engineering ViewMaster 80 **(** -or a Videx-compatible 80 column card.)

◊ The Apple IIGS, Laser 128, and the Franklin Ace 2000 series computers have built-in extended 80 column display circuits.

If you have more than *1.5* megabytes of RAM (including RamFactor and auxiliary slot memory expansion cards) installed in your system, Applied Engineering recommends that you protect your Apple system from excessive heat build-up with a cooling fan, such as the System Saver® from Kensington Microware. These specially designed fans are available from many computer dealers.

When the Apple power supply was originally designed, it was capable of providing more than adequate power for the memory and accessory cards available at the time. Newer expansion cards with more memory and more features consume more power, possibly taxing the Apple power supply to its limit.

If most of the slots in your computer contain expansion cards or the system has a large amount of RAM, you may overload the original power supply. The power supply has an internal protection circuit which turns the power supply off for a second and then turns it back on to check for the presence of the overload condition. If your computer mysteriously reboots itself intermittently or the power indicator light inside the computer flashes, your system may require more power.

Applied Engineering offers two solutions to the power users:

Solution 1: RamCharger™ RamFactor Auxiliary Power and Battery Back Up. This solution provides constant, uninterruptable power to RamFactor, independent from the Apple power supply. This way, information stored in RamFactor is protected in the event of a power failure. RamCharger also decreases the burden on the Apple power supply. More details on the RamCharger option are given in Appendix A.

Solution 2: Applied Engineering High Output power supply. The Apple power supply is capable of a maximum output of 35 Watts. (The Watt is a unit of power.) The High Output supply, which installs in place of the original supply, has an output rating of 77 Watts.

Into The Computer

Installing RamFactor in an Apple or Franklin Ace 1000 series Computer

1. Switch the computers power switch to the OFF position, but leave the power connector plugged in.

2. Remove the top cover of the computer.

3. Discharge any static electricity that may be on your body or clothing by gently touching the power supply. **This is very important.** Static electricity can seriously damage both the card and the computer.

4. Remove the RamFactor from its anti-static bag. Do not touch the gold edge connectors.

5. Insert the RainFactor's gold edge connector in any expansion slot except slot 3. If you have an Enhanced Apple //e and wish to boot from the RamFactor card when a Control-Reset is executed, install the RamFactor in slot 7. If you will be using Pascal 1.3, install the RamFactor in slots 4, 5, or 6. Do not attempt to install the RamFactor card in the auxiliary slot.

   IIGS users can boot from the RamFactor in any slot by accessing the Slots option in the Control Panel Menu and setting the Startup option to the correct slot.

6. Replace the computer's top cover. Installation is complete.

Installing RamFactor in a Franklin Ace 2000 series Computer:

1. Turn the power switch to the OFF position. Leave the computer plugged in.
2. Remove the cover in accordance with the instructions provided in your Franklin's User's Reference Manual.
3. Refer again to the User's Reference Manual for instructions on installing an expansion card in expansion slot S4/S7. Configure the jumper-clip to emulate either slot 4 or 7.
4. Replace the cover. Installation is complete.

Installing RamFactor in a Laser 128 Computer:

1. Turn the power switch to the OFF position. Make sure the POWER indicator light on the front panel is off. Leave the computer plugged in.
2. Remove the RamFactor card from its protective anti-static bag. Do not touch the gold edge connector.
3. The use of the Laser 128 two-slot expansion box is recommended. Insert the gold edge connector into the desired slot of the expansion box. If you wish to install RamFactor directly into the Laser 128, position the RamFactor card component side up and insert the gold edge connector into the expansion slot on the left side of the Laser 128 computer. Be very careful not to touch the exposed RamFactor card when the computer's power is on!
4. Installation is complete.

What Next?

You don't have to test your RamFactor card, but if you'd like to, Appendix B tells you how.

What you should read next in this manual depends on how you will use RamFactor. You may stop right here if you will be only using RamFactor to improve the performance of a program written specifically for RamFactor or the Apple Memory Expansion Card. If you want to use RamFactor and the AppleWorks Expander disk to enhance the performance of AppleWorks, read Chapter 2. Or skip to Chapter 3 for details on using RamFactor as a RAMdisk.

2: The AW 2 Expander™ for RamFactor

About the AppleWorks Expander disk

AppleWorks is the best-selling program from Apple Computer that combines a word processor program, data base program, and spreadsheet program into one "integrated software package. Earlier versions of AppleWorks, written for an Apple //e with only 128K of RAM, are limited to an AppleWorks Desktop size of *55K*. AppleWorks version 1.3 and 2.0 will automatically recognize the extra RAM available on RamFactor and Gs-RAM and use this memory to expand the AppleWorks Desktop size. This allows the AppleWorks user to create larger individual Desktop files, but does little else to enhance performance. The AW 2 Expander takes care of the enhancements!

The AW 2 Expander modifies the **AppleWorks 2.0** program to recognize and use the additional memory provided by Applied Engineering's memory enhancement products. It will also add enhancements to AppleWorks 1.3 and patch AppleWorks 1.2 through 2.0 so that it will run on an Apple][Plus. (1.3 users and][Plus users, refer to the chapter, AppleWorks for the Apple][Plus for details.)

AppleWorks enhancements created by the AW 2 Expander include:

- Increased Desktop Size (for RamWorks & Z-RAM products)
- Up to 22,600 records in the Data Base (versus 6350 records)
- Up to 22,600 lines in the Word Processor (versus 7250 lines)
- Word Processor and Data Base Clipboard expanded to 2,042 lines (versus 250)
- Multiple disk file-saving capability

- Printer Buffer (for RamWorks and Z-RAM products)
- Print-file cache
- Buffer size option (for IIGS)
- Reserve RamFactor size for use as a RAMdisk (for RamFactor--see note for RamWorks/Z-RAM in the *About the New Features* section)
- On-screen time display option (with ProDOS clock)
- Data Base time-stamp capability option (with ProDOS clock)
- Expander options menu (accessible whenever AppleWorks is booted)

The AppleWorks 2 Expander is a menu driven utility program which will automatically add the enhancements to your AppleWorks 2.0 STARTUP and PROGRAM disks. The AppleWorks Expander modification is required only once. Even if you add memory to your RamFactor you won't need to run this utility again. After the modification, AppleWorks will still function as before, except it will have the added features.

Also contained on the AW 2 Expander disk are several test programs you can run to verify the operation of your Æ memory expansion card (e.g. RamFactor, RamWorks, GS-Ram or Z-RAM).

What you will need...

~ An Apple IIGS, //e or compatible computer system capable of running an unmodified version of AppleWorks 2.0.

or

~ An Apple IIGS, //e or compatible computer system capable of running an unmodified version of AppleWorks 3.1. (See Chapter 5.)

or

~ AppleWorks 1.3 or 2.0 and an Apple II Plus (or compatible) with a ViewMaster 80 (Videx-compatible 80 column card) in slot 3, a 16K Language Card in slot 0 (or TransWarp accelerator), and a RamFactor in any available slot. (See Chapter 5.)

~ Backup copies of both your AppleWorks disks and your AW 2 Expander disk. See Appendix C of this manual or your Apple User's Guide for information on making BACKUP disks.

IMPORTANT NOTES:

- We recommend that you use the AW 2 Expander to enhance AppleWorks 2.0 (or later). V2.0 is available from your authorized Apple dealer. If you have AppleWorks 1.2 or 1.3, or if you are using an Apple][Plus, refer to the next chapter, *AppleWorks for the Apple][Plus*, for a list of features.

- If you are using AppleWorks 1.3 with your RamFactor, the AW 2 Expander will use the Apple][Plus enhancements to modify it. This means that the desktop will not be enlarged, nor will your maximum number of lines/records be increased.

- If you are using an Applied Engineering RamWorks card or a GS-RAM card along with your RamFactor card, you can modify your AppleWorks 2.0 disks with either the AW 2 Expander program provided with those boards or with the AW 2 Expander for RamFactor program, but not with both. Both programs are virtually identical and either program will work. AppleWorks will automatically use your RamWorks (128k or larger) or GS-RAM card for expanding the Desktop and leave the RamFactor memory free for use as a RAMdisk.

- If you are using V1.3 with your RamFactor and want to enlarge the desktop and increase the maximum number of records and lines you will need the **RamFactor Expand** program available from Applied Engineering sales.

- Do not modify your ORIGINAL AppleWorks disks! (See Appendix C.)

- Use this utility only on unmodified copies of AppleWorks STARTUP and PROGRAM disks. Any patches to AppleWorks required by other programs, such as Pinpoint or MacroWorks, should be made after the AppleWorks Expansion. If you have an Applied Engineering TimeMaster card installed in your computer, the AppleWorks Expander will install AppleWorks Time Utilities option for time display and data base date stamping.

- These instructions assume that you already know how to use AppleWorks. The AW 2 Expander program uses the same screen displays and keyboard input routines ("user interface") as the AppleWorks program. If you need a quick review, read *Throughout AppleWorks* in your *Using AppleWorks* manual.

- There is an AppleWorks Word-Processor file on the AW 2 Expander disk entitled "**READ .ME**." Please do so. This document will contain information about any recent changes to the software or updates to the documentation.

- If you plan to use the Printer Buffer option, you must have a printer interface which supports Apple's Pascal 1.1 protocol for status-checking. (Most newer interfaces do support this standard.) For more information, please refer to *Printer Buffer Option* in the section entitled *About the New Features.*

AppleWorks 2 Expander Instructions

AppleWorks expansion is a two part process. First, you will use the AW 2 Expander utility to modify some of the program files on the AppleWorks startup and program disks. Then, you will boot the modified AppleWorks disk and add or change the limits on the enhanced features by accessing a special options menu.

Part 1 - Modifying the AppleWorks disks

This is how to use the AppleWorks Expander utility to modify the AppleWorks STARTUP and PROGRAM disks:

1. **First, make copies of your original AppleWorks disks and the AW 2 Expander disk.**

   Filer (provided on the AW 2 Expander disk) or the System Utilities should be used for this purpose.

2. **Boot the copy of the AW 2 Expander disk** in your startup drive.

3. **Select the option, "Execute AppleWorks Enhancements."**

   The Applied Engineering AW 2 Expander copyright screen will then appear. Read each of the screens, pressing the space bar to continue, until you reach the "Modify Startup" screen.

4. **Remove the AW 2 Expander disk and insert a copy of the AppleWorks STARTUP disk in drive one** as prompted.

   Be sure the WRITE PROTECT tab has been removed from the disk. As prompted at the bottom of the display screen, press the space bar to continue or the ESC key to go back to the main menu.

   The AW 2 Expander program expects to find the AppleWorks Startup file, "APLWORKS.SYSTEM," on the disk in drive one. If, at this point, the program displays the following message:

Unable to find file. Type prefix of AppleWorks to modify

type, "AppleWorks" after the slash or enter the complete ProDOS prefix of the AppleWorks STARTUP disk. If you have copied the AppleWorks program to be modified into a ProDOS subdirectory, enter the complete ProDOS pathname of the subdirectory containing the AppleWorks files. Be sure to include any slashes *(/)* for subdirectories. An example ProDOS prefix of

an AppleWorks subdirectory on a Profile hard disk (with a volume directory name of /PROFILE) might be:

/PROFILE/APPLE WORKS

5. **Press "Y"**

   When the program finds the AppleWorks disk, it will automatically determine which version it is, 1.2, 1.3 or 2.0, and display a list of the modifications it will make. Pressing "Y" in response to the question, "Do you wish to continue?" will begin the modifications. Pressing "N" will return you to the main menu.

6. The message, "Working" will appear at the bottom of the screen.

The modifications will be made very quickly.

7. Insert the **PROGRAM disk and press the space bar.**

   After the STARTUP disk has been successfully modified, you will be prompted to remove it from the disk drive and insert a copy (write enabled) of the AppleWorks PROGRAM disk--unless all of the AppleWorks startup and program files are contained in the same directory (i.e. Disk 3.5 or hard disk). If the program and startup files are on the same directory, no disk swapping is necessary. The volume directory name of this disk must be the same as the STARTUP disk. Press the space bar to continue.

8. **Boot the modified disk.**

   When the modification to the AppleWorks PROGRAM disk has been completed, the message:

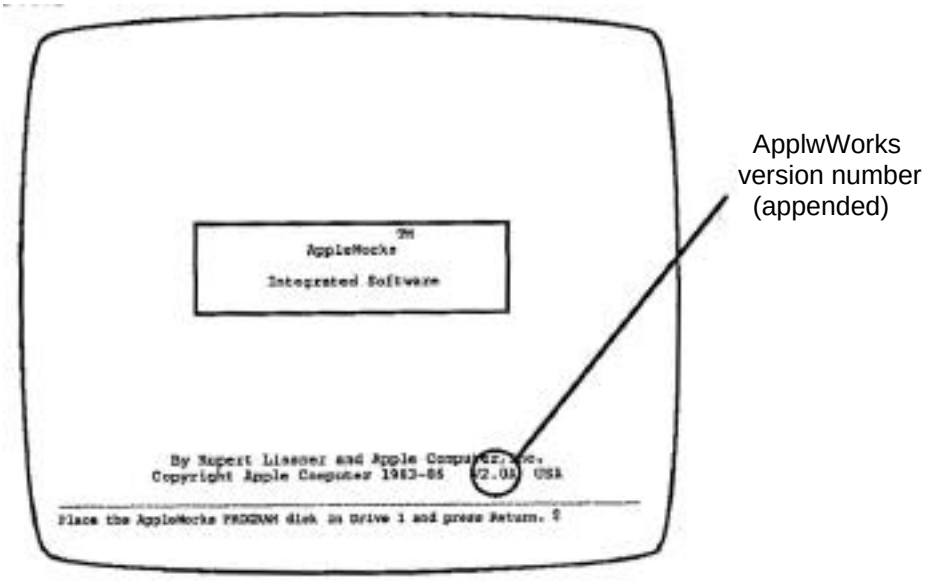
Modification Successfully Completed

appears on the screen. The program will beep the computer's speaker and exit to the ProDOS Quit code. The modified AppleWorks disks can now be booted in the normal manner. Note that the modified AppleWorks startup screen now shows an "A" appended to the version number (ex: V2.OA). (If you used the][Plus patch, a "+"will be appended to the version number instead of an "A. ") See the illustration on the next page.

9. **Make other modifications.**

   Any modifications required by other AppleWorks accessory programs should be done at this time. (You may wish to make a archive copies of the modified AppleWorks disks prior to any other modifications.)

AppleWorks Version Number



10. Copy to hard disk.

If you will be using the modified AppleWorks from a hard disk drive, copy the modified AppleWorks files to the hard disk according to the instructions provided with your hard disk file management program.

11. Load AppleWorks onto your RamFactor.

If you want to load AppleWorks onto your RamFactor, here's how:

~ Select Filer from the disk menu.
~ Select File Commands ("F")
~ Select Copy Files ("C")

~ Type in the AppleWorks disk pathname followed by an equal sign (ex: /AppleWorks/=). The equal sign is a wildcard command meaning, "copy all files."

~ Type in the Pathname for your RamFactor followed by an equal sign (ex: /Ram7/=).

~ Press the "Return" key. A list of the files being copied will appear on the screen.

~ Copy is complete. The AppleWorks program can now be run from your RamFactor.

The next very important step, explained in Part 2 of this procedure, is to access the enhanced AppleWorks' Getting Started options menu and configure the program disk's parameter file with the desired expander options. (It s not as difficult as it sounds.)

Part 2 - Set the AppleWorks enhancement options

1. **Boot the AppleWorks startup disk** just like you normally would.

   (Notice that the Expander has appended an “A” (or a “+“) to the AppleWorks version number near the lower right corner of the startup screen

2. **Remove the startup disk and insert the program disk** when the startup disk has finished loading. **DO NOT press return. Press the ESCape key instead**.

   If you boot AppleWorks from a Disk 3.5 or a hard disk, press the ESC key when you are prompted with: “Press the Space Bar to continue."

   Note: You do not need to access the Getting Started options menu each time you boot AppleWorks. Use the Getting Started menu to set the enhanced AppleWorks options only.

The current enhancement options configuration will be read from the parameter file (SEG.PR) on the AppleWorks program disk and displayed in the Getting Started option menu. The configuration shown below contains the default settings. These default settings remain in effect until you change them and save the new configuration back to the AppleWorks program disk.

The Getting Started options menu:

```
File: None                GETTING STARTED
================================================================
```

```
Getting Started

1. Maximum Records/Lines(RW)          12,000
2. Preload AppleWorks onto Memory        On
3. Printer Buffer(RW)                   Off
4. Buffer Size(GS)                      0 K
5. Reserved RamFactor Size (RF)         0 K
6. Time Display                         Off

7. Save Configuration
8. Continue with AppleWorks
```

```
Type number, or use arrows, then press Return          1113K Avail.
```

3. **Use the Up Arrow and Down Arrow keys to highlight the option you want. Use the Return key to select a highlighted option.**

   For more information on the options, refer to the section entitled, *About the New Features,* in this chapter.

4. **Save the new configuration** back to the AppleWorks program disk by selecting the menu option, "Save Configuration," after you have made the desired changes.

5. **Choose the option, "Continue with AppleWorks"** to continue booting the AppleWorks program.

   If you did not save your new configuration, the new one will be in effect only until you quit the AppleWorks program. The next time you boot AppleWorks, it will use the previous (saved) configuration.

About the New Features

The following paragraphs describe the new features of the Expanded AppleWorks and the instructions for using them. Please read this section very thoroughly.

Desktop Expansion

The Desktop-expansion (over 56K) feature already built into AppleWorks 2.0 requires one of the following cards:

RamFactor Card (Apple //*e* only)
Apple II Memory Expansion Card (Apple //e only)
GS-RAM or GS-RAM Plus (Apple IIGs only)

The built-in desktop expansion feature will automatically recognize and use RamFactor and GS-RAM memory as increased Desktop space. The AW 2 Expander enhancements allows you to partition that space for use as RAMdisk. See description following.

The AW 2 Expander software allows AppleWorks to use RamWorks or Z-RAM memory to expand the Desktop, enabling you to work with larger Desktop files. It does not increase the maximum number of files (12) you can have on the Desktop at one time. The Desktop expansion feature requires a minimum of 192K of system memory (128K of auxiliary memory).

Additional Records and Lines

With sufficient memory, the maximum number of Word Processor lines available with the unenhanced AppleWorks 2.0 is limited to *7,250;* the maximum number of data base records is 6,350. The enhanced version expands the maximum number to just over 22,600 for both.

When a RamFactor, GS-RAM or GS-RAM Plus is used, the enhanced AppleWorks automatically sets the number of lines and records to the maximum (22,600) and any changes to the Maximum Records / Lines option will be ignored.

When a RamWorks or Z-RAM card is used, the Getting Started options menu allows a choice of maximum lines and records. (The initial default is 12,000) In order to achieve the extraordinary increase in the number of lines and records, some Desktop space has to be sacrificed. As you set the maximum lines and records, remember that each additional 1000 lines/records requires about 2K of memory (Desktop) space.

Clipboard Expansion

The standard AppleWorks clipboard is limited to only 250 lines of information. The enhanced AppleWorks clipboard expansion increases the clipboard size for the Word Processor and Data Base functions to 2,042 lines. Only clipboard activities within and originating from the Spreadsheet function remain limited to 250 lines.

AppleWorks Auto-load Feature

> Note: The Auto-Load and Preload features described below require at least 190K of Desktop memory.

AppleWorks 2.0 has a built-in “Preload” feature which will automatically find your memory expansion card and load the AppleWorks special functions into memory. This greatly increases the speed of AppleWorks; it does not have to access the external drive for the PROGRAM disk information.

AppleWorks 1.3 and earlier did not have the Preload feature but the AW 2 Expander adds a feature to ill, referred to as “Auto-Load,” that performs much like the Preload feature Apple has added to version 2.0.

AppleWorks 1.3 was designed for use with only 64K of additional memory, so not all of the AppleWorks program functions are loaded into memory during program startup; some functions, like displaying help screens, adding files, or using the clipboard, are left on the disk and retrieved only when they are needed. RamFactor allows you to “auto-load” these functions into memory, minimizing the time consuming disk

accesses and allowing you to move between Desktop files and AppleWorks' functions very quickly.

The Auto-Load feature loads the rest of the AppleWorks 1.3 program into memory. This extends the AppleWorks startup time by about a minute. The PROGRAM disk startup screen will display a counter indicating the number of functions remaining to be loaded. (During the countdown it may appear that the counter has skipped a function. This is because some functions are relatively small and loaded faster than indicated by the counter.) Pressing the Escape key during this count-down will stop the loading of special functions and immediately display the AppleWorks Main Menu. AppleWorks will access the functions in memory that were loaded before the Escape key was pressed and access the PROGRAM disk for those functions which had not been loaded.

The AppleWorks special functions are loaded into RamFactor's memory, but they don't decrease the size of the available Desktop. Magic? Nope! The functions are originally "hidden" in an unused portion of the Desktop memory and as the files on the Desktop grow larger, the special functions are individually "bumped" from memory to make room. If AppleWorks can't find a special function in memory it will go back to the PROGRAM disk.

This brings up an interesting point about the convenience of using the Auto-Load and Preload features to replace the AppleWorks PROGRAM disk in drive one of a single disk system. If you have all of the program functions Auto-Loaded (or Preloaded) in memory, you can first specify drive one as the standard location of your data disk and then replace your PROGRAM disk with your data disk. Keep your PROGRAM disk handy, though. You'll need to insert it whenever AppleWorks tries to access something that has been bumped from memory. Please refer to your AppleWorks Reference Manual for more details on the selection of a standard location for your data disk.

> Note: If you copy all AppleWorks STARTUP and PROGRAM disk files to the RamFactor and execute the program from its emulated RAMdisk, the AutoLoad/Preload feature is not required. This method of executing AppleWorks can be tricky and should not be attempted by those not familiar with AppleWorks and Apple ProDOS. (PROfessional Disk Operating System.)

The Preload feature for version 2.0 as well as the Auto-Load feature for version 1.3 can be turned on or off with the Getting Started menu option, Preload AppleWorks onto Memory. 2.0 users can use the option to turn off the auto-load feature instead of pressing ESC while AppleWorks is loading. Refer to the AppleWorks 2.0 user's manual for more information about the built-in Preload feature.

Multiple Floppy Disk Files

Data storage problems arise when the size of a file on the Desktop exceeds the amount of storage space on the data disk. A 5.25" floppy disk can store only 135K of AppleWorks data. A 3.5" disk can hold 800K. Using the modified AppleWorks, Desktop, files larger than the available disk space will be segmented, or "split", and saved in sections to two or more disks. The following paragraphs explain how to use this feature to save and load segmented Desktop files.

This seems to be a good time to remind you of Murphy's Law:

Whatever can go wrong will go wrong.

Back up your Desktop files! A power failure will wipe out anything currently on the Desktop! It's always a good idea to have backup copies of your working data disks, especially if you have large amounts of data stored on them.

Saving Desktop Files to Disk

When saving a Desktop file which is larger than the data disk space available, the enhanced AppleWorks will prompt the user with the following message:

```
Segmented Desktop File...
Please insert NEXT disk with SAME VOLUME NAME
```

> Note: If a previous version of the file already exists on the disk, AppleWorks 2.0 will first ask you if you wish to delete the old file. 1.0 through 1.3 will automatically delete the old file before the new file is saved.

Remove the data disk from the current disk drive and replace it with the next data disk. All segments of a given segmented Desktop file MUST be saved on data disks having the same volume (disk) name as the primary (first) data disk. There must be at least one block of free space on the first data disk! If there isn't, the "unable to begin" error message will be displayed and you will have to delete a file on the disk or create a new primary data disk. On subsequent data disks, each appended file segment (sequential) will be automatically deleted before saving a new segment.

If you discover that you don't have enough formatted blank disks with the same volume name, don't panic! Just use the AppleWorks Disk Formatter utility under the "Other Activities" menu. First, press the ESC key to stop saving the Desktop file and to return to the AW Main Menu. Do not turn the computer off. Doing so will erase the Desktop file from memory.

Adding multiple-disk tiles to the Desktop

When adding multiple-disk, or segmented, files to the Desktop, the file MUST be loaded from the data disks in the same sequence as it was saved. AppleWorks will prompt the user to insert the NEXT data disk(s) until the file is completely loaded.

If you list the files on disks that contain segmented files you will notice that the first segment has the filename that you gave it. The next segment (on the NEXT disk) will have a ".2" appended to the end of your filename. The next disk in the sequence would have a ".3" appended to the filename and so on. This is the way AppleWorks keeps track of the segmented Desktop file sequence. You will probably want to label your data disks in such a way that you too can keep track of the proper sequence.

Printer Buffer Option (RamWorks and Z-RAM)

This feature is only available when the AppleWorks Desktop is expanded using RamWorks or Z-RAM memory. It is not available when only a RamFactor is used. The Apple IIGS has a built-in print buffer that you can activate from the Apple IIGS control-panel menu. (The next section describes Buffer Size Option for the Apple IIGS.)

If your RamWorks or Z-RAM has 256K or more memory, the Printer Buffer option will automatically enable you to continue working with files on the AppleWorks Desktop even while your printer is printing. With sufficient memory, the buffer will support two printers printing at the same time, each printing multiple files. The relative size of the print buffer is determined by the amount of available Z-RAM or RamWorks memory. It does not affect the size of the desktop.

> Note: This feature will not work with all printer interfaces. It was designed to work with all standard interfaces supporting the Pascal 1.1 protocol for status checking. If you cannot get this option to work, your interface does not support this official protocol. The Apple //c serial ports support this standard, but some serial-to parallel printer-interface converters do not. Contact the manufacturer of your printer card or converter for details on upgrades.

As the Desktop file to be printed is being loaded to the buffer, the message "Filling buffer. . ." will appear on the screen and the printer will begin printing. If the printer is printing an exceptionally large file and the computer seems to be locked in the "Filling buffer... "mode, it is probably caused by insufficient buffer space. The AppleWorks Desktop will return as soon as there is enough space in the buffer for the remainder of the print file.

Pressing the ESC key while the print buffer is filling will cause AppleWorks to stop sending the remainder of the print file to the buffer. Sending an (-Control-C from the keyboard at any time while the printer is printing will reinitialize (clear) the AppleWorks internal print buffer. If your printer or printer interface has an internal print buffer of its own, the printer may continue to print the remaining contents of its buffer even after the AppleWorks buffer has been cleared.

Buffer Size Option (GS only)

The Buffer-Size option of the Getting Started option menu only affects the size of the Apple IIGS' internal print buffer. (Remember to activate the computers print buffer by using the Apple IIGS control panel.) Since the print buffer on the Apple IIGS is handled differently from the RamWorks/Z-RAM print buffer, this feature has no effect when used on an Apple //e or //c.

The Buffer-Size option of the enhanced AppleWorks Getting Started option menu lets you allocate the amount of Apple IIGS memory space (up to 64K) to be used for the print buffer. With the Apple IIGS print buffer ON and the Getting Started Buffer-Size option set to 0 K, the actual buffer size will be determined by the amount of memory (2K or less) that the Apple IIGS memory manager can allocate. Please refer to your Apple IIGS *Owner's Guide* for more information about the internal print buffer.

Print-File Cache

One small file (SEG.PR) on the AppleWorks program disk contains special configuration information about such things as your printer information, standard location of your data disk, and enhancement options. The unmodified version of AppleWorks leaves this information on the program disk and is not preloaded along with the program overlays. Whenever AppleWorks needs information from this file it prompts you to reinsert the AppleWorks program disk. The enhanced version of AppleWorks loads this file into memory at startup and eliminates the need for the program disk (until overlays are bumped from memory). Only when you change the contents of this file (i.e.: add, remove a printer, etc.) does the enhanced AppleWorks prompt you to insert the program disk.

Reserved RamFactor Size (RamFactor*)

This option allows RamFactor users to partition the desired amount of RamFactor Memory for use as a RAMdisk. Otherwise, AppleWorks will use all available memory to expand the desktop. Since the memory on RamWorks and RamFactor are handled differently, this setting has no effect when used with RamWorks.

> *Note: We have also provided features with the RamWorks and Z-RAM products that allow you to control how the memory is used. Refer to the *Partition* and *ProDrive* instructions in each manual.

Time Display/Data Base Time-Stamp Option

This option was designed to read the output of the Z-RAM Ultra clock, Serial Pro clock, Apple IIGS internal clock, TimeMaster H.0., or any other ProDOS compatible clock and replace the "Open-Apple-? for Help" message in the bottom line of the AppleWorks screen with a current date and time display. This option also allows the AppleWorks user to enter the current date or time into a Data Base category by typing the @ character as the only entry in that category. The category name must contain either the word DATE or the word TIME but should not contain both. For example, you should not use this feature in a category named "Date and Time."

The Getting Started options menu allows 12 hour or 24 hour time and date display. How the date is displayed on the screen and stamped in the Data Base is affected by the time display option selected.

> The 12-hour (USA format) option displays the date as Month/Day/Year.
>
> The 24-hour (French, German, and military format) option displays the date as Day/Month/Year

The "AECLK.SYSTEM" file, required by the //c System Clock, Z-RAM Ultra, and Serial Pro clocks, can be installed to the AppleWorks STARTUP disk before or after using the AW 2 Expander. The instructions for installing the AECLK.SYSTEM file are provided in the appropriate Æ clock~Product user's manual.

To use the internal clock of the Apple IIGS, the enhanced AppleWorks must be run under ProDOS 8 or 16, not ProDOS 1.1.1. Refer to your IIGS manual for details about the internal clock.

3: Apple Works for the Apple][Plus!

Introduction

This chapter tells you what you need to modify and use AppleWorks on the Apple][Plus computer. You should also refer to this chapter if you are using the AW 2 Expander disk to add certain enhancements to AppleWorks V1.2 or 1.3 for use with your lle or IIGS. The directions for an optional, easy to install "Shift Key" modification supported by the modified AppleWorks program is also included in this chapter.

About the AppleWorks Expander and the][Plus

AppleWorks was originally written for the Apple //e, not the][Plus. If you try to boot the AppleWorks STARTUP disk in a][Plus system, all you get is the error message: "APPLEWORKS REQUIRES AN 80 COLUMN //E." The AppleWorks Expander is a menu driven utility program which will modify, or patch, your AppleWorks STARTUP disk, enabling AppleWorks to run on the][Plus. The AppleWorks Expander will also make the necessary software modifications to compensate for the differences between the Apple //*e* and the Apple][Plus. The version of AppleWorks and the amount and type of memory you have in your Apple] [Plus determine what features and options are available to you.

Here's what the AppleWorks Expander can do for Apple][Plus users:

Enable AppleWorks 1.2, 1.3, or 2.0 to run on the Apple][Plus.

Note. The AW 2 Expander will modify AppleWorks 1.2 so that it will run on a][Plus but version 1.2 will not recognize the RamFactor's memory and, consequently, will not expand the desktop when used with a RamFactor.

Patch AppleWorks to support the ViewMaster, Videx or SuprTerm compatible 80 column display.

Support alternate keyboard commands to emulate Apple lle keys not available on the Apple][Plus keyboard.

Preload AppleWorks into memory* for improved AppleWorks speed; fewer disk accesses (for versions 1.3 and 2.0 with a RamFactor).

Give AppleWorks multiple disk file-saving* capability.

Reserve RamFactor memory* for use as a RAMdisk (for V1.3 and 2.0).

Allow on-screen AppleWorks time display*. (Option for ProDOS compatible clock cards.

Support Data Base time-stamp* (option).

*These features are also added to the 1.2 and 1.3 versions for use on a IIe or IIGS. See *About the New Features* in the previous chapter for descriptions of these enhancements

SOFTWARE Required:

An Applied Engineering AW 2 Expander utility disk.

Warning: Use the AW 2 Expander only on backup COPIES of your AppleWorks disks! Store your original disks in a safe place.

AppleWorks, version 1.2, 1.3, or 2.0. (See above for other versions.)

If you have access to a computer that will boot AppleWorks (//e, //c, or IIGS), the version number is indicated on the AppleWorks Startup screen. See the illustration, *Apple Works Version Number.* Version 2.0 is recommended. Contact your Authorized Apple Dealer for an upgrade to the latest version.

Minimum HARDWARE Required:

An Apple][Plus with 64K of Random Access Memory (RAM). An Apple][won't do! It has to be an Apple][Plus with Applesoft BASIC in ROM and 48K of RAM on the main board.

Note: AppleWorks 2.0 will not support exponential functions in the spreadsheet when used with a 64K machines. An Apple][Plus must have either a TransWarp or an extra Pocket Rocket for exponential functions.

A 16K Language Card in slot 0. (See the note about TransWarp™' below).

A ViewMaster or Videx compatible or SuprTerm compatible 80 column display card in slot 3.

Note: to run AppleWorks version 1.2 you must use a ViewMaster 80.

A video monitor capable of displaying 80 column text.

At least one disk drive.

Optional Hardware:

RamFactor card in any available slot.

Applied Engineering's TransWarp accelerator card in any available slot.

(Highly recommended! - The TransWarp card will increase the processing speed of the computer and functions as the 16K language card.)

TimeMaster H.O. or any ProDOS compatible clock card.

Enhancing AppleWorks

Now that you know what you need, follow the step-by-step enhancement instructions in the previous chapter called, *AppleWorks Expander Instructions.*

Alternate AppleWorks Keyboard Commands

Since the Apple II Plus keyboard does not have the up arrow, down arrow, or open-Apple keys, these keys, which are required by AppleWorks, must be emulated through the magic of software. To enter an Open-Apple command on the][Plus keyboard, press and release the Esc key, then press the appropriate letter or number key. For example A would be entered as Esc A; 4 would be Esc 4. Cursor positioning and other special keys are described in the chart below. Control commands are entered by holding the Control key down while pressing the appropriate letter key.

Apple //e Keyboard	Apple I[Plus Equivalent
Return	Control M or Return
Cursor Up	Control K
Cursor Down	Control J
Cursor Right	Control U or
Cursor Left	Control H or
Tab	Control I
Escape	Esc Esc
Delete	Esc #
@	Esc "
^	Esc =
_	Esc -
\	Esc &
|	Esc !
'	Esc '
~	Esc $
[	Esc <
]	Esc >
{	Esc (
}	Esc)

Lower Case Characters

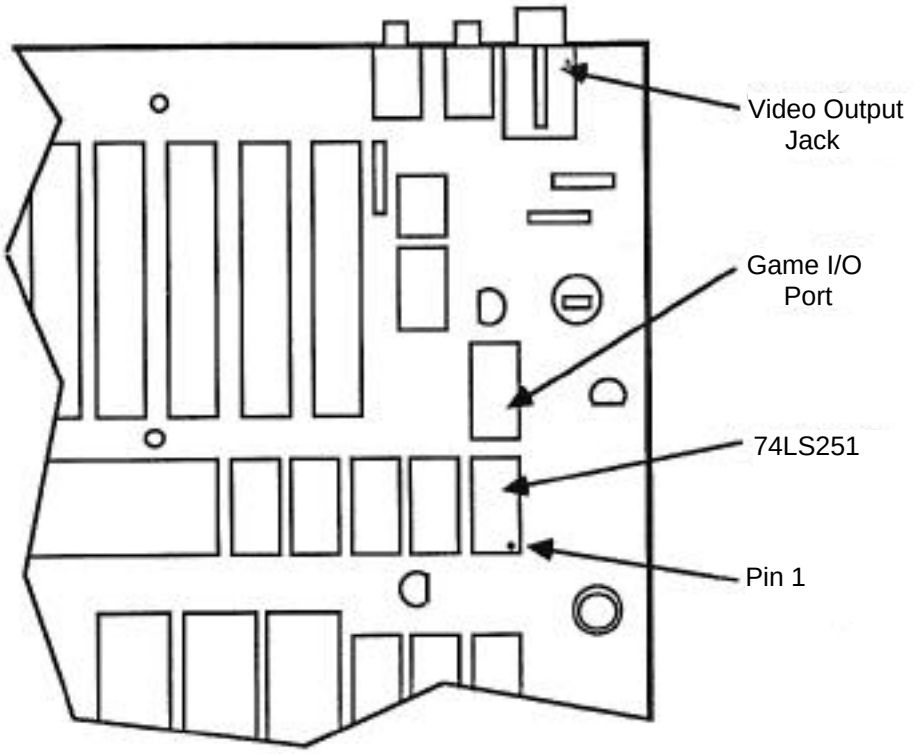
When the modified AppleWorks is booted it automatically enters lower-case mode. To toggle this shift lock feature between upper and lower case use Control-A. (Press the A key while holding the Control key down.)

Optional Shift Key Hardware Modification (For Rev 7 or later motherboard)

Using the modified AppleWorks with this one wire modification, the shift key becomes a real shift key, eliminating the need to constantly toggle Control-A. The only part required is readily available at your local Radio Shack® store. It is called a "Mini Clip Lead" and the part number is 278-016.

1. Turn the computer off and remove the top cover.
2. Connect one end of the mini-clip wire to **pin 1** of the **74LS251** integrated circuit "chip," which is just forward of the Game **I/0** connector (toward the keyboard). See illustration 3-1.
3. Connect the other end of the mini-clip wire to **pin 24** of the keyboard encoder connector. This connector is a row of 25 parallel wires extending between the keyboard and the keyboard encoder circuit card suspended below it. Pin 1 of this connector is nearest the power supply; pin 25 is nearest the right side of the computer. (...pin 24 is second from the right.)
4. Replace the top cover, boot the modified AppleWorks, and shift!

Illustration 3-1 Location of the 74LS251 on the Apple][Plus main circuit board



4: *Putting RamFactor to Work*

Introduction

In the previous two chapters, RamFactor was used to enhance the performance of AppleWorks 1.3 and 2.0 which were specially written to take advantage of RamFactor's extra memory. If you are using AppleWorks 1.3 or 2.0 or an application program that automatically utilizes RamFactor memory in this manner, then you probably have no need for the information contained in this chapter. This chapter explains how to use RamFactor as a RAMdisk. It will explain how to create a RAMdisk in the operating system of your choice, how to copy files to the RAMdisk, and how to execute programs from the RamFactor RAMdisk. Although you don't have to be an experienced programmer to use the RAMdisk feature of RamFactor, you should have a working knowledge of the applicable operating system.

Remember that a RAMdisk is a volatile data storage medium! If the power is turned off, all information stored in the RAMdisk disappears. Be careful how you use the RAMdisk feature. Back up your data often and consider RamCharger™, the battery backup option for RamFactor. (See Appendix A.)

How RamFactor emulates a solid-state RAMdisk depends on the operating system booted into the computer. The following sections describe how RamFactor is used with these different operating systems: ProDOS, DOS 3.3, CP/AM *5.1***,** and Pascal 1.3.

> **WARNING:** Don't try to boot an unformatted RamFactor RAMdisk using the PR# command! If you do, you'll find yourself in the RamFactor Partition Manager program. Chapter 4 has the details on the accessing and using the Partition Manager.

ProDOS RAMdisk

When a ProDOS based startup disk is booted, ProDOS automatically recognizes the RamFactor card as a DATA disk with the volume name /RAMs, where ***s*** is the number of the slot containing the RamFactor card. You can store your data files in the ProDOS DATA disk or load programs to it and run them, but you can't start up from (boot) the DATA disk. To create a PROGRAM RAMdisk, or one that can be booted, you must first format the ProDOS RAMdisk.

Formatting a ProDOS RAMdisk

Use Apple Computer's FILER program to *format* the RAMdisk. For your convenience, FILER is provided on the AppleWorks Expander disk. If you've never used the FILER before, the instructions are in the ProDOS User's Manual or are available in the FILER's tutorial HELP screens. Here's an outline of the FILER's format procedure:

1. Boot the AppleWorks Expander disk; select the Exit to BASIC option from the Main Menu.

2. At the Applesoft BASIC prompt **( ]),** use the ProDOS Dash command to run the FILER program. Type: —FILER.

3. From the FILER main menu select option "V"; then "F" from the Volume Commands menu.

4. Enter the number of the slot containing the RamFactor card. For the new volume name enter: RAMS, where s is the RamFactor slot number. **(-** or name it anything you like.)

5. Answer "Y" to the "DESTROY 'RAMs'?(Y/N)" prompt. Your RamFactor RAMdisk is formatted in less than a second.

6. Press the ESC key twice to return to the FILER main menu; press **"Q"** to access the Quit and Load screen. Just press the Return key to get back to the AppleWorks Expander Main Menu.

Copying files to a ProDOS RAMdisk.

Treat the ProDOS RAMdisk just like any other ProDOS volume. Files can be copied to or from it by using a file-copy utility program, such as Apple's FILER, Central Point Software's Copy II Plus (version *6.5* or later), or Applied Engineering's AUTOCOPY2. Do not use volume-copy options to copy another disk to a RAMdisk -use only the file-copy options. Remember that you are copying the contents of one disk to another; you are not duplicating a disk.

Note: Only files which are not copy-protected can be copied to a ProDOS RAMdisk, although some copy protection schemes will allow files to be copied from a floppy disk to a hard disk *or RAMdisk* but not another floppy disk.

Once PRODOS and the required system file (e.g. BASIC.SYSTEM) are copied to the RAMdisk, it can be booted with the PR#s command, where *s* is the number of the slot containing the RamFactor card. If RamFactor is installed in slot 7 of an Enhanced Apple //e, the RAMdisk can be booted using the Control-Open Apple-Reset method. Or if you

have RamCharger, your Enhanced //e will be able to boot from the RAMdisk upon power-up!

Any attempt to access or format a RamFactor RAMdisk that has already been formatted under a different operating system will result in a "WRITE PROTECT" error message. To clear the RAMdisk, remove power from the RamFactor card. (i.e. turn the computer and battery backup option switch OFF.)

AUTOCOPY Instructions

Included on the AppleWorks Expander disk is an Applesoft BASIC utility program, AUTOCOPY2, which will allow you to copy all of the files on one or more floppy disks (or hard disks) to a ProDOS RAMdisk. The authors of AUTOCOPY2 tried to make the program as simple to use as possible, but it does require you to have an elementary knowledge of ProDOS commands and pathnames. The basics of pathnames, directories, subdirectories, and filenames are explained in the ProDOS User's Manual.

Select the "Execute AutoCopy" option from the AppleWorks Expander disk Main Menu. AUTOCOPY2 will display this prompt:

Enter name of volume directory to copy (<RETURN> to quit)
/

Carefully type the volume name of the floppy disk containing the files you wish to copy. The leading ProDOS slash (/) delimiter is provided; just enter the volume name character string. The ending delimiter is optional. To correct an entry before the return key is pressed, use the left arrow key to backspace over the error, and enter the correct characters. Next you are prompted to enter the destination subdirectory:

Enter name of destination volume or subdirectory /

Again, the leading ProDOS slash (/) delimiter is provided; type the desired volume or subdirectory name. if a destination subdirectory is specified which does not already exist, AUTOCOPY2 will automatically create it. The contents of any subdirectories encountered under the source pathname will be copied to subdirectories created by AUTOCOPY2 under the destination pathname.

The equal sign (=) can be used as a wildcard to substitute for the *trailing characters* of a source filename character string. This is best explained with the following example:

Enter name of volume directory to copy (<RETURN>to quit)
/PFS.FILE/FILE=

In this example, only the files with filenames beginning with "FILE" on the /PFS.FILE volume would be copied to the destination.

AUTOCOPY2 can also be executed from Applesoft BASIC. Program execution can be from the immediate (BASIC prompt) or deferred (within a BASIC program) mode.

> **IMPORTANT:** If AUTOCOPY2 is to be copied to and executed from another disk, it will be necessary to also copy the GET.LEN file to that disk. GET.LEN must be under the same directory as the AUTOCOPY2 program.

Customizing AUTOCOPY2

If you are familiar with the BASIC programming language, you will be able to alter certain AUTOCOPY2 program statements (lines), allowing the program to be used as an automatic (STARTUP) program, capable of copying multiple volumes or pathnames to a RAMdisk.

The user options are conveniently contained in AUTOCOPY2 program lines 40 through 44, inclusive. The statements beginning with line 45 are string array elements, containing the multiple source and destination pathnames. The initial default option settings are shown in Example 1 below and explained in the following paragraphs.

Example 1:

```
40 PROMPT = YES
41 ASKFILE = NO
42 EXITFILE$ = ""/?"
44 MULTIVOL = NO
45  MV$(0)  =  "/?":MU$(0)  =  "I?"
46  MV$(1)  =  "/?":MU$(1)  =  "I?"
47  MV$(2)  =  "/?":MU$(2)  =  "I?"
```

Line 40 PROMPT = In the default state (YES) AUTOCOPY2 will prompt you to insert the source disk and press return. If changed to PROMPT = NO, the program will scan the system for the source pathname and begin the copy process.

Line 41 ASKFILE = The default setting (NO) will cause AUTOCOPY2 to automatically copy all files encountered under the source pathname. Changing this option to YES, you will be asked to confirm each file before it is copied. This allows selective copying of files when desired.

Line 42 EXITFILE$ = This option allows you to name a file to be executed upon completion of the copy process. The default (EX1TFILE$ = "/ ?") will cause the program to display "COPY COMPLETE" when all files have been copied, set the current prefix to the boot drive, and exit to the BASIC prompt. The EXITFILE must be an executable program file and should be specified by its COMPLETE pathname. The EXITFILE routine will automatically insert the ProDOS DASH *(—)* command.

Line 44 MULTIVOL = if MULTIVOL = NO the program uses only the option parameters specified in program lines 40 through 42, inclusive. The multiple source and destination pathnames described in the next paragraph are ignored.

if MULTIVOL = YES the program will use the pathname string arrays it finds beginning with line 45. Up to ten additional source (MV$) and destination (MU$) string array elements may be created as required. When the program encounters a source or destination array element which contains "/?" it will prompt you for keyboard input for that element.

The equal-sign (=) can be used as a wildcard to substitute for the trailing characters of a source character string, as shown in this example program line:

45 MV$(0) = "/PFS.PLAN/PLAN&':MU$(0) = "/RAM7/PFS"

Only the files with filenames beginning with "PLAN" on the /PFS.PLAN volume would be copied to the /RAM7/PFS subdirectory.

The program lines shown in Example 2 will load the contents of the AppleWorks startup and program disks to the /RAM7/APPLE WORKS/ subdirectory. Since line 40 is set to YES, AUTOCOPY2 will prompt you twice to insert a volume with the name of /APPLEWORKS. (...the AppleWorks STARTUP and PROGRAM volumes.) When all files have been copied to the ProDrive, AUTOCOPY2 will execute the EXITHLE$ string in line 42.

Example 2:

```
40 PROMPT = YES
41 ASKFILE = NO
42 EXITFILE$ = "/RAM7/APPLEWORKS/APLWORKS.SYSTEM"
44 MULTIVOL = YES
45 MV$(O) = "/APPLEWORKS":MU$(0) = "/RAM7/APPLEWORKS"
46 MV$(1) = "/APPLEWORKS":MU$(1) = "/RAM7/APPLEWORKS"
```

The options specified in Example 3 tell the AUTOCOPY2 program to automatically copy all files beginning with "FILE" on the /PFS.FILE volume to the /RAM5/PFS subdirectory and prompt you for the next source and destination pathnames. After all files have been copied, the program will then execute the EXITFILE$. (FILE.SYSTEM is the PFS:File startup program.)

Example 3:

```
40 PROMPT = YES
41 ASKFILE = NO
42 EXITFILE$ = "/RAM5/PFS/FILE.SYSTEM"
44 MULTIVOL = YES
45 MV$(0) = "/PFS.FILE/FILE=":MU$(0) ="/RAM5/PFS"
46 MV$(1) = "/V:MU$(1) = "/?"
```

Note: PFS software is copy-protected. Program files can be copied to a ProDrive and executed, but they are "keyed" to the PFS program master disk which must be in the startup disk drive. See your PFS program user's manual for more information about executing programs from a hard disk or RAMdisk.

DOS 3.3 RAMdisk

Booting a DOS 3.3 disk does not automatically create a DOS 3.3 RamFactor RAMdisk. You must first inform the operating system (DOS 3.3) that there is a RamFactor card in the computer by using the IN#s command, where ***s*** is the number of the slot containing the RamFactor card. This command links the RamFactor card to the DOS 3.3 operating system in memory.

The number and sizes of the emulated DOS 3.3 volumes (disks) created by the TN#s command depends on the amount of RAM available on the RamFactor card. Use the chart, below, to determine the number and size of your DOS 3.3 RAMdisk volumes.

RamFactor Memory Size	Number of Drives	Drive Size	Maximum files per Drive
256K	1	140K	105
512K	1	400K	217
768K	1	400K	217
1024K	2	400K	217

These RAMdisk volumes are just like initialized DOS 3.3 DATA disks. They can contain information, even programs, but they can't be booted. To be a bootable startup disk, a PROGRAM disk, the slot ***s,*** drive 1 RAMdisk must contain the DOS 3.3 operating system.

The DOS 3.3 operating system can be installed using the INSTALL DOS program on side 2 of the AppleWorks Expander disk. Boot the back side of the AppleWorks Expander disk in your startup drive and select the "Install DOS 3.3 to RamFactor" option. The program automatically finds the RamFactor card and installs the DOS 3.3 "boot tracks." (The INSTALL DOS program can also be executed from Applesoft BASIC by

typing BRUN INSTALL DOS at the BASIC prompt.) After DOS 3.3 is installed, the RAMdisk can be booted just like any DOS 3.3 volume. Use the PR#s command from the BASIC prompt. If you have an Enhanced Apple //e and your RamFactor is in slot 7, use can use either PR#7 or Control-Open Apple-Reset to reboot the DOS 3.3 RAMdisk. (Non-enhanced Apples will not boot from a RAMdisk card using the Control-Open Apple-Reset method.)

If another standard DOS 3.3 startup disk is booted while the RamFactor DOS 3.3 RAMdisk is active, the new operating system will have to be linked to the RAMdisk with the IN#s command. Any attempt to access or format a RamFactor RAMdisk that has already been formatted under a different operating system will result in a 'WRITE PROTECT" error message. To clear the RAMdisk, remove power from the RamFactor card. (i.e. turn the computer and battery backup option switch OFF.)

When you use the INIT command with the modified DOS 3.3 in memory, keep this in mind: The image of DOS written on the initialized floppy disk will be the patched RAMdisk version DOS. The initialized disk will be "tied" to the RamFactor card and its current slot. For the floppy disk to successfully booted, the RamFactor card will have to be installed in the same slot as when the disk was initialized.

Copying Files to the DOS 3.3 RAMdisk.

Standard (not copy-protected) DOS 3.3 files can be copied to the RamFactor's RAMdisk using the Apple File Developer program (FID). The FID program is especially useful for transferring all types of DOS 3.3 files. For your convenience the FID program has been included on the DOS 3.3 side of the AppleWorks Expander disk. FID can also be found on the Apple DOS 3.3 System Master disk (FID is a binary program and is executed by typing BRUN FID at the BASIC prompt.)

FID can be used in combination with a text file to create a turnkey file copy utility program. This is a quick way to transfer a selected list of files to a DOS 3.3 RAMdisk. The text file contains a list of commands used to run the FID program, set up the source and destination disks, and list the files to be copied. The EXEC command is used to start processing the text file's commands. See the DOS Users Manual for more information on EXECuting text files.

An example EXEC (text) file, COPYM, is included on the DOS 3.3 side of the AppleWorks Expander disk. This sample file instructs the FID program to copy certain files on the disk to the RAMdisk. To use this sample file, boot the disk and select the "Copy Files to RamFactor" option. This menu option will automatically link the RAMdisk to DOS and EXECute the COPYM text file, which will copy INSTALL DOS and FID to a RAMdisk. (COPYM is a sample text file; it assumes the RamFactor is in slot 7 and the floppy disk interface is in slot 6.) This

program can also be executed by typing EXEC COPYM from the Applesoft BASIC prompt.

You must customize COPYM for every desired combination of source and destination slots and drives. Customization is easy with any DOS 3.3 based word processor program which saves files to disk in text file format (like DOS 3.3 AppleWriter). The text file listing, below, provides a line by line description of the sample COPYM file. When creating an EXECutable text file for FID, be sure that none of your filenames contain any DOS 3.3 commands. (e.g. **READIING.1; CATALOG LIST**) Also each line must end with a carriage return.

Text file:	Contents of Comments
BRUN INSTALL DOS	Installs the modified image of DOS 3.3 on the RAMdisk.
MON C,I,O	Use this line to monitor the program execution sequence on the screen.
BRUN FID	Executes the FID program.
1	Select option 1 (Copy Files) from the FID main menu.
6	Specify slot 6 as the source slot.
1	Specify drive 1 as the source drive
7	Specify slot 7 as the destination slot.
1	Specify drive 1 as the destination drive.
INSTALL DOS	Filename of first file to copy.
S	Press any key to continue.
1	Select option 1 (Copy Files) from the FID main menu.
FID	Filename of next file to copy.
S	Press any key to continue.
9	Select option 9 (Quit) from the FID main menu.
CATALOG	DOS command to list the directory of the destination disk.

Here's another example text file. This one will copy all files on the source disk to the destination disk:

Contents of Text file:	Comments
BRUN INSTALL DOS	Installs the modified image of DOS 3.3 on the RAMdisk.
MON C,I,O	Use this line to monitor the program execution sequence on the screen.
BRUN FID	Executes the FID program.
1	Select option 1 (Copy Files) from the FID main menu.
6	Specify slot 6 as the source slot.
1	Specify drive 1 as the source drive
7	Specify slot 7 as the destination slot.
1	Specify drive 1 as the destination drive.
	Wildcard character; copies all files on the source disk.
N	Cancel individual file prompting.

After customizing your own COPYM text file, making a turnkey startup disk is easy with the following 'HELLO' program:

```
10 REM Turnkey HELLO program
20 PRINT CHR$(4);"EXEC COPYM"
30 END
```

Pascal 1.3 RAMdisk

The Pascal 1.3 operating system automatically recognizes the RamFactor card, when installed in slot 4, ***5,*** or 6, as a Pascal volume with the name RAMs, where s is the number of the slot containing the RamFactor card. Programs written under Pascal 1.1 or 1.2 are not compatible with RamFactor. Please contact your authorized Apple dealer for possible upgrade information.

This RAMdisk volume can be used and accessed just like any other Pascal 1.3 volume. To create a bootable Pascal RAMdisk, use the Pascal FILER to determine the volume number of the RAMdisk and format it using the FORMATTER program (APPLE 3). Then, using the FILER again, copy SYSTEM.PASCAL and SYSTEM.APPLE to the RamFactor volume.

CP/AM 5.1 RAMdisk

To use RamFactor or a RamFactor partition as a CP/AM RAMdisk, Applied Engineering's Z-80 Plus co-processor card and the CP/AM 5.1 operating system are mandatory requirements. The previous version of the operating system, CP/AM 4.0B, will not recognize the RamFactor card.

All utility programs needed to create and use the RamFactor as a CP/AM RAMdisk are supplied on the CP/AM 5.1 System Master disk and full documentation is provided in the CP/AM 5.1 User's Guide. These products are included with the Z-80 Plus card, or can be purchased separately from Applied Engineering.

5: RamFactor Partition Manager

About the Partition Manager

The RamFactor Partition Manager (RPM) is actually a program permanently stored in in ROM (Read Only Memory) on the RamFactor card. This menu-driven program enables you to organize RamFactor's memory into multiple work areas, or partitions. From one to nine partitions can be created, each partition functioning as an independent RAMdisk. Each RAMdisk partition can be dedicated to one of the operating systems supported by RamFactor. Be sure you've read the Chapter 4, *"Putting RamFactor to Work."* It tells you how to prepare RAMdisk (the active partition) for data storage and make it a bootable device.

Accessing the RamFactor Partition Manager (RPM) menus

To enter the RamFactor Partition Manager main menu, just type *PR#s* from the Applesoft BASIC prompt. *(s* is the number of the slot containing the RamFactor card.) Press Control-Reset to enter the Applesoft BASIC mode, indicated by the left bracket (]) prompt.

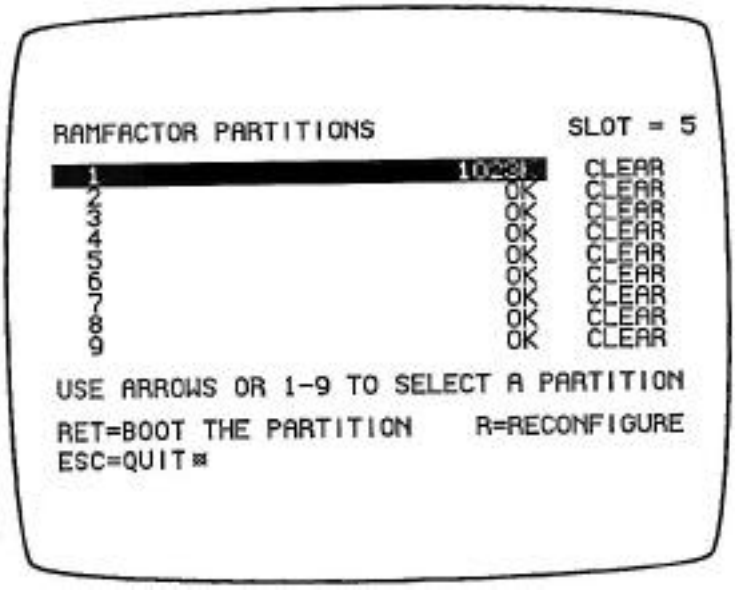
Before the RamFactor Partition Manager program can be initially activated, the RamFactor RAMdisk must be CLEAR and unformatted. If your RAMdisk is currently formatted, the PR#s command will cause the computer to boot into the RAMdisk instead of the RPM program. The easiest way to clear a RAMdisk is to turn the computer off momentarily (about *5* seconds). Another way is to force the computer to access the RPM program by using a special Monitor command. At the BASIC prompt, type **CALL —151** and press **Return.** This will place the computer in Monitor command mode, indicated by the asterisk **(*)** prompt. Enter **Cs10G** and press **Return**. *(s* is the number of the slot containing the RamFactor card.) This message will appear:

```
WARNING- INSTALLING PARTITIONS DESTROYS
THE DIRECTORY- GO AHEAD?
```

Press **Y** for yes or any key to abort and boot from another slot.

Once the RPM program is activated, the RPM main menu, shown in Illustration 5-1, will allow you to select RamFactor partitions and configure them to suit your needs.

Illustration 5-1 RamFactor Partition Manager main men



Selecting a RAMdisk Partition

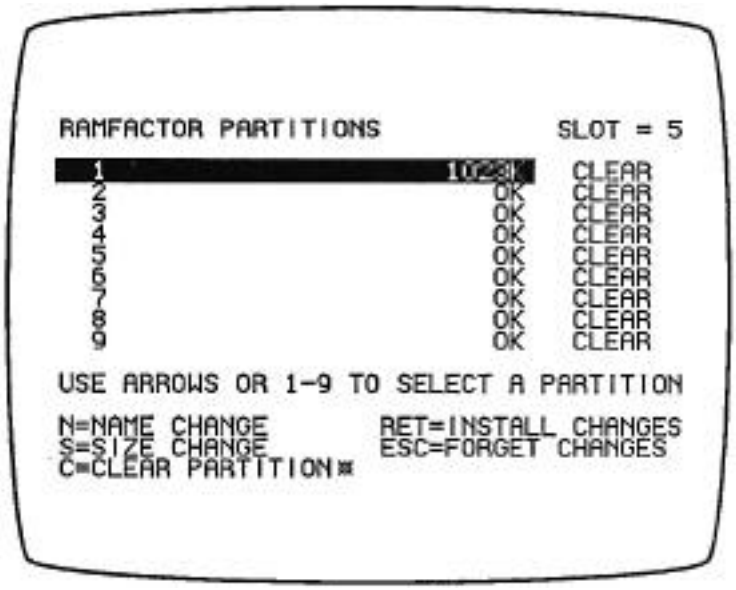
The currently selected partition is highlighted on the RPM main menu by the inverse video bar. The arrow keys can be used to move the highlight bar up or down to select a different partition. Pressing the **Esc** (Escape) key will exit the RPM program and return to the operating system (if any) previously loaded. The highlighted partition then becomes the current, or active, partition.

Only one partition at a time can be active. The active partition RAMdisk can be accessed without affecting the contents of the other partitions and the inactive partitions are totally invisible to the system.

Configuring a RAMdisk Partition

Pressing the **R** key from the RPM main menu will display the configuration options, shown in Illustration 5-2.

Illustration 5-2 RPM partition configuration options



Naming a Partition

Selecting the **N** option will allow you to name the highlighted partition. Each name, which can contain up to 16 characters, is stored in RamFactor's memory. The partition name has no meaning to the partition's operating system, it is just a label for your convenience. A partition name can be erased by reselecting the **N** option, then pressing **Return.**

Clearing a Partition

The **C** option will completely erase the previous contents of the selected partition. A cleared partition is indicated by CLEAR in the status column on the right side of the RPM screen.

Sizing the Partitions

Pressing the S key will enable you to change the size of the currently selected CLEAR partition. To create more than one partition, you must first change the size of the first partition. Any remaining available memory will be added to the size of the next (numerically) partition. Move the selection bar to the next partition, select the S option, and enter the desired size. If you are re-configuring existing partitions, the partitions to be changed must be cleared before they can be re-sized. Remember that changing the size of an existing partition will affect the size of the next partition, which will also need to be cleared prior to re-sizing.

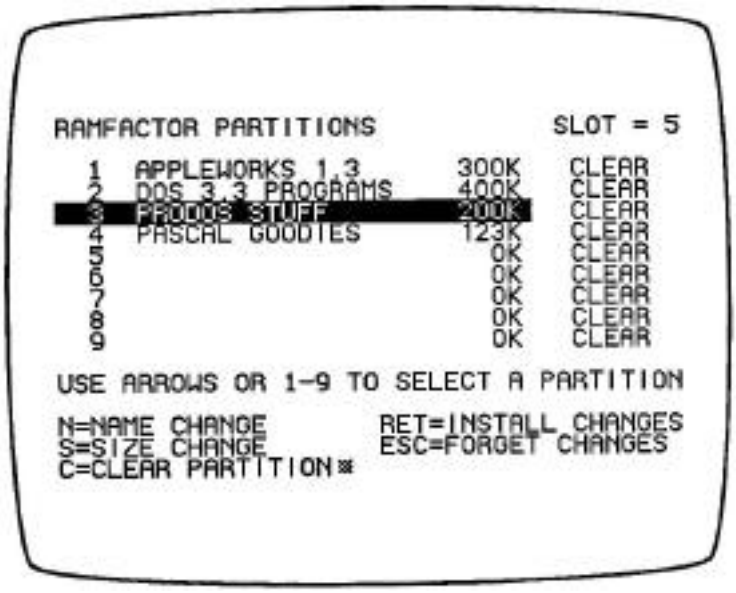
You may have noticed that the partitioned memory is 1K less than the total amount of RamFactor memory. When a blank RamFactor is accessed for the first time, all of the available RamFactor memory is dedicated to one RAMdisk. Upon activating the RPM program, all of the available RamFactor memory, except 1024 bytes (1K), is dedicated to the first partition. Regardless of the amount RamFactor memory available, 1K is reserved for use by the RPM program. Notice in Illustration ***5-1,*** a one megabyte (1024K) RamFactor has 1023K of partitionable memory. All other partitions are empty (0K) and CLEAR.

Partitions to be formatted under ProDOS and Pascal 1.3 can be set to any size desired. The sizes allowed for DOS 3.3 partitions have certain restrictions, shown in the chart, below. The number and storage capacity of DOS 3.3 emulated drives depends on the the size of the partition.

Partition Size	DOS 3.3 Volumes
less than 140K	will not format for DOS
140K-279K	one 140K volume
280K-399K	two 140K volumes
400K-799K	one 400K volume
800K or more	two 400K volumes

The sample video screen shown in illustration 5-3 gives an example of four partitions named, configured, and ready for formatting. Once the desired changes have been made, press the **Return** key to accept the changes and return to the main menu. Or press **Esc** to cancel any changes and revert to the previous partition settings.

Illustration 5-3 Example partition configuration

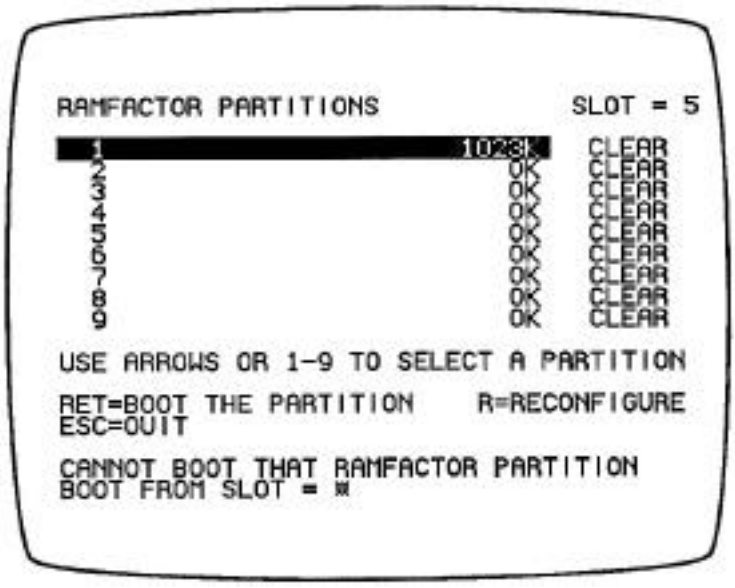


Booting a Partition

To boot from the active partition, its RAMdisk must contain a bootable operating system and any required startup files. Please refer to Chapter 4, *Putting RamFactor to Work,* for details on creating a bootable RAMdisk partition.

Any bootable partition can be booted by accessing the RPM menu and pressing the numeric key representing the desired partition. The partition will boot automatically. Pressing the **Return** key from the main menu will attempt to boot the highlighted partition. If a partition is not bootable, RPM will prompt you for the slot number of your boot drive, as shown in Illustration *5-4.* Enter the slot number of a disk drive containing a bootable disk and press **Return**.

Illustration 5-4 RPM unable to boot from partition selected



Note to Enhanced Apple //e Users: If RamFactor is the first device in the boot sequence (e.g. slot 7) a **Control-Open Apple-Reset** command will attempt to boot the active partition, bypassing the RPM menu. If the current partition is not bootable, the next device in the boot sequence is accessed (e.g. slot 6).

Changing Partitions

To enter a different partition, you must reboot (PR#*s)* the RamFactor Partition Manager, select the new partition, and boot the new partition or

simply exit the RPM program. This can be compared to removing a floppy disk from the boot drive and booting or accessing a different program disk. Since the active partition must be deselected to select another, files cannot be transferred directly from one partition to another.

Any attempt to access or format a partition formatted under an operating system different from the one currently in memory will result in a "WRITE PROTECTED' error message. To reformat a partition it must first be cleared, using RPM configuration menu option C, then formatted under an active operating system.

IMPORTANT !

Any programs which use RamFactor memory directly to enhance their performance must be executed from the first partition only. AppleWorks 1.3 is such a program. It uses whatever RamFactor memory is available in the first partition area to expand the AppleWorks Desktop space.

6: *RamFactor Technical Reference*

Introduction

The first section of this chapter tells you how to add additional memory chips to your RamFactor card and how to run the RamFactor Diagnostic program. The next section deals with highly technical information usually required only by advanced programmers or software developers.

Adding Memory to RamFactor

The RamFactor card can contain up to 1024K (1 Megabyte) of Random Access Memory. This memory is organized into four 256K blocks, each block consisting of eight 256K RAM chips.

Selection of the proper RAM chips for RamFactor can be tricky. There are several chip manufacturers and many different types and specifications of chips available. RamFactor requires 256K x 1 dynamic RAM (DRAM) chips with a speed specification of 150 nS (nanoseconds) or faster. Another very important specification for RamFactor memory chips is the "CAS before RAS" method of memory refresh.

You may be able to find memory chips with the proper specifications at some computer or electronics-parts stores. But we recommend that you purchase them from Applied Engineering. Applied Engineering receives bulk-quantity discounts on purchases of memory chips and can often offer them for less. Applied Engineering uses only the highest-quality memory chips and warrants them for a full 5 years. (Most electronics-parts vendors sell their chips "as-is.") We will not warrant chips purchased from other vendors. When you get ready for more memory, give Applied Engineering a call. You'll be assured of getting the right chips at the right price. (214) 241-6060 Monday through Friday, 7 days a week.

Approved manufacturers and chips are:

Hitachi	HM50256-15
Mitsubishi	M5M4256P- 15
Fujitsu	MB8 1256-15
OKI	MSM41256A-15AS,'Rs
Intel	P21256-15
Samsung	KM41256-15
Micron Technologies	MT1259-15
Toshiba	TMM41257-15

Memory Chip Installation

There is nothing complicated about installing RAM chips on the RamFactor card. Just keep these basic guidelines in mind:

> Refer to Illustration 6-1. Fill the RamFactor RAM chip blocks in order. In other words: If blocks A and B are populated, fill C not D

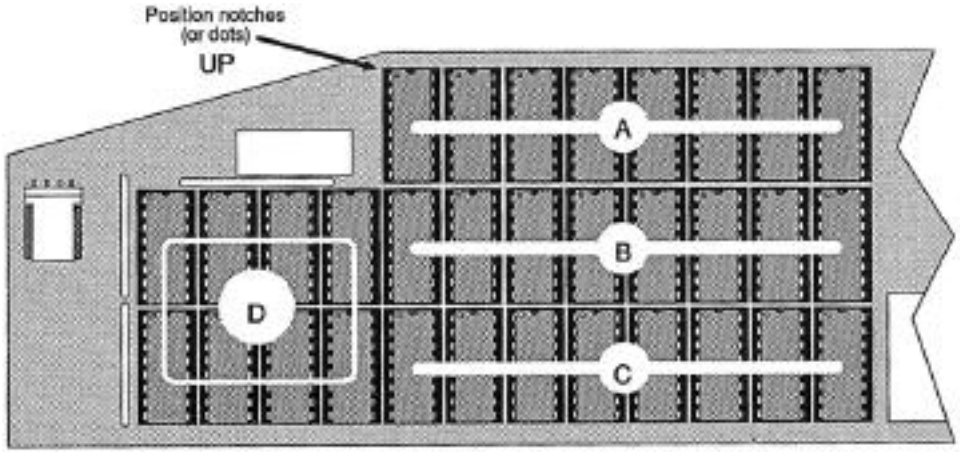
> Handle the RAM chips very carefully. Avoid touching the pins or bending them excessively.

> When inserting a chip, make sure the notch, or dot on some brands of chips, is pointing UP, away from the gold edge connector on the bottom of the card. See illustration 6-1.

> Press down firmly on each chip. Make sure that ALL pins are securely seated in the socket. Check closely for bent pins.

> Be careful! Applying power to a chip which has been incorrectly installed can ruin the chip.

Illustration 6-1 RamFactor RAM chip blocks



RamFactor Diagnostic Program

After installing chips to the RamFactor, you may want to test the card. Instructions for testing the RamFactor card are in Appendix B of this manual.

> **WARNING:** The RamFactor Diagnostic program is a destructive memory test. It will erase anything stored in RamFactor memory.

NOTE:
The remainder of this chapter is intended for heavy-duty programmers interested in developing application software for the RamFactor card.

Description of RamFactor

The RamFactor is a peripheral expansion card which functions primarily as a mass storage device. It works with ProDOS, Pascal 1.3, and DOS 3.3. RamFactor was designed to be totally compatible with virtually all software written for the Apple II Memory Expansion Card. It also provides some additional useful features not available on the Apple card. These features include:

RamFactor Partition Manager firmware, which enables RamFactor memory to be subdivided into partitions, with each partition totally isolated from the others.

Expansion port for addressing additional memory beyond the 1 Megabyte available on the main RamFactor circuit card.

Connector for RamCharger™ an optional uninterruptable power source for RamFactor RAM.

RamFactor Partition Manager Firmware

When a blank RamFactor is first accessed by either ProDOS or Pascal 1.3, the RamFactor firmware dedicates all of RamFactor's RAM to that operating system as a formatted data disk. The RamFactor Partition Manager firmware remains inactive until called by a PR#s from BASIC or a Cs l0G command from the Monitor. (This feature allows RamFactor to be fully Apple II Memory Expansion Card compatible, until the RPM firmware is called.) Once the RamFactor RAMdisk has been configured

as a bootable device, the only way to access the RPM firmware is by the Cs1OG command.

When an Enhanced Apple lle system is cold booted, the RamFactor firmware (ROM) determines whether the card has been formatted and is bootable. If it is bootable, it will boot into the appropriate operating system. If not, the Apple ROM will continue with the slot search for the next bootable device. Apples with non-enhanced firmware will not support either the RamFactor or the Apple II Memory Expansion card as a cold-bootable device.

Whenever a PR#s command is issued or execution starts at Cs00, the RamFactor ROM again determines whether the card is bootable. If the RAMdisk is bootable the ROM will boot into the appropriate operating system. If a non-bootable RAMdisk is encountered, the ROM will enter the RamFactor Partition Manager firmware. Since an unpartitioned, bootable RamFactor RAMdisk will not allow access to the RPM firmware using the PR#s command, use the Cs l0G command to force the activation of the RPM firmware. But remember, this will cause the entire contents of the RamFactor to be cleared.

Whenever the IN#s command is issued, the RamFactor ROM checks for the presence of the DOS 3.3 operating system. If DOS 3.3 is not found, the IN#s command has the same effect as the PR#s command. That is, if a bootable non-DOS 3.3 RAMdisk is present, it will boot; if not, it will access the RPM firmware. If DOS 3.3 is found, the RamFactor firmware will patch the RWTS routine, allowing access to the RAMdisk.

By activating the RamFactor Partition Manager firmware, the card is divided into nine partitions, with all of the available memory except 1024 bytes being in the first partition. The other eight partitions are initially empty. The remaining 1024 bytes is reserved for use by the firmware. For example, a one Megabyte RamFactor first accessed by ProDOS would yield a 1024K RAMdisk. When the Partition Manager was called, the first partition would then yield 1023K. Once the card has been formatted into the nine partitions, access through DOS, ProDOS, or the Protocol Converter will deal with the currently selected partition. Once the RPM firmware has been accessed, recalling the RPM menu to select another partition is accomplished via the PR#s command. The PR#s command does not boot a bootable partition.

When the RamFactor Partition Manager is accessed, the firmware downloads a program from the RamFactor firmware to regular Apple RAM. The partition menu program uses memory from $800 to $EFF, so any Applesoft program currently in RAM will be over-written. (Normally you will be changing programs anyway, so this is not a problem. The same thing happens when you use PR#s from a regular disk drive.)

ProDOS

When you boot ProDOS or ProDOS-based applications, the currently selected partition of the RamFactor card is automatically linked in as a ProDOS RAMdisk with a volume directory name /RAMs. If you have previously set up partitions on the RamFactor card, it will use the currently selected partition. To make the ProDOS RAMdisk a bootable device, it must *first* be formatted and loaded with the necessary startup files, just like any ProDOS mass storage device.

Pascal 1.3

Pascal 1.3 automatically recognizes a blank RamFactor RAMdisk as a formatted Pascal storage volume with the name RAMS, where *s* is the number of the slot containing the RamFactor card. Pascal requires that the RamFactor be installed in slots 4, 5, or 6 only. (Earlier versions of Pascal do not support the ProDOS block device protocol or the Protocol Converter, required to interface with the RamFactor.)

The procedure for making the RamFactor RAMdisk a Pascal startup volume is the same as for any other Pascal volume.

DOS 3.3

When RamFactor initializes a DOS partition, the size of the partition or the amount of memory affects how the volumes will be established:

Partition Size	DOS 3.3 Volumes
less than 140K	will not format for DOS
140K-279K	one 140K volume
280K-399K	two 140K volumes
400K-799K	one 400K volume
800K or more	two 400K volumes

The first volume is accessible as Drive 1, the second as Drive 2. The smaller volumes are exactly the same size as standard Apple floppy disks. These are 35 tracks, with 16 sectors per track. Each sectors holds 256 bytes. This computes to 143,360 bytes, which is called 140K (where "K" stands for a multiplier of 1024). The larger volumes have 50 tracks with 32 sectors per track, giving 400K bytes. In both cases, track 17 ($11) is used for the catalog information. A small volume can catalog up to 105 files. A large volume can catalog up to 217 files.

RamFactor initializes a DOS volume like a "data" disk. That is, there is no bootable DOS image in tracks 0, 1, and 2. You can make any DOS partition bootable by selecting that partition and using the binary program, INSTALL DOS, to copy the DOS image from memory into the first 32 sectors of the current partition. In addition, a short boot routine is written

at the beginning of the very *first* sector. INSTALL DOS does not have any effect on the previous contents of the rest of the partition, so any files you had on the partition will still be there. INSTALL DOS assumes the file name of the startup program will be “HELLO”.

Patches Made to DOS 3.3

When you boot standard DOS 3.3, it has no way of telling that your RamFactor is present. You inform DOS 3.3 of the presence of a RamFactor card in slot s with the command IN#s. When the IN#s command is executed, RamFactor firmware installs a three-byte patch inside DOS. This patch, placed at $BDl2-BD14, jumps to a special entry point inside the RamFactor firmware whenever RWTS is called. The patch was carefully designed so as not to conflict with the method used by various hard disk systems to link to DOS 3.3 (such as Corvus and Sider).

Once the RamFactor patch is installed, all DOS commands may be used with the DOS volumes in the current partition. You can switch to a different partition by using the PR#s command, which brings up the RamFactor partition menu.

Note that only one RamFactor card can be linked into DOS 3.3 at any given time. However, if you have more than one card, you can use the IN#s command to link any card just prior to accessing it. The IN#s command has no other effect than patching the firmware link at $BDl2.

If for some reason you wish to remove the firmware link without re-booting DOS 3.3, you can do so by restoring the original contents of the three bytes at $BD12-BD14. For example, the monitor command “BD12:AA A0 0F” will do so. From inside Applesoft, you can POKE the values:

POKE 48402,176 POKE 48403,160 POKE 48404,15

If you use the INIT command to initialize a floppy disk after installing the RamFactor firmware link (with the *IN#s* command), the DOS image written on the floppy disk will include the firmware link. This means that the RamFactor card will have to be installed (and in the same slot) for that floppy to successfully boot. (If you have a Sider Hard Disk, you may have already discovered a similar fact about the Sider firmware link.)

Operating System Identification

The RamFactor firmware determines which operating system is in use by examining the contents of location $BF00. This technique was chosen to be compatible with the Apple Memory Expansion Card.

($BF00) = $00 -- Pascal
($BF00) = $4C -- ProDOS
($BF00) = $33 -- DOS 3.3

RamFactor Hardware

The RamFactor card has five addressable registers, which are addressed according to the slot number the card is in:

$C080+slot * 16	low byte of RAM address
$C081+slot * 16	middle byte of RAM address
$C082+slot * 16	high byte of RAM address
$C083+slot * 16	data at addressed location
$C08F+slot * 16	Firmware Bank Select

After power up or Control-Reset, the registers on the card are all in a disabled state. They will be enabled by addressing any address in the firmware page $Cs00-CsFF.

The three address bytes can be both written into and read from. If the card has one Megabyte or less, reading the high address byte will always return a value in the range $F0-FF. The top nybble can be any value when you write it, but it will always be "F" when you read it. If the card has more than one Megabyte of RAM, the top nybble will be a meaningful part of the address.

When you read or write the data byte, the address automatically increments. Some 6502 address modes cause two accesses at the same location, which in this case can cause double incrementing. To avoid double incrementing, use either absolute addressing, or an indexed form with the base in a different page. For example, with the RamFactor in slot 4, you could use:

```
LDA $C0C3          absolute addressing
  or
LDY #$C8           slot * 16 +$88
STA $BFFB,Y $C083-$88,Y
```

Whenever the lower or middle address byte changes from a value with bit 7 = 1 to one with bit 7 = 0, the next higher byte is automatically incremented. This means that you should always load the bytes in the order low-middle-high, and always load all three of them. (Unless, of course, you are sure of the previous contents and can be sure you will get predictably correct results.)

Finding the RamFactor Card

A program can search the slots for a RamFactor card by looking for a unique pattern in various firmware locations. The bytes at $Cs00-Cs07 are standard for both the Apple Memory Expansion Card and the RamFactor card. They are:

$Cs00:C9 20 C9 00 C9 03 C9 00

In addition, the byte at $CsFB on a card of this type has bit 0= 1. For RamFactor, the whole byte = $01. The byte at $CsFA distinguishes between the various brands of memory expansion cards. RamFactor has $AE at this location.

Finding RamFactor's Size

There are several ways a program can find out the size of the RamFactor card, or the size of the current partition.

If you are using ProDOS, the ProDOS status call can be used. The methods for finding the ProDOS firmware entry point, and for making a status call, are explained on pages 112-115 of Apple's "ProDOS Technical Reference Manual" and on pages 6-6 through 6-11 of Quality Software's "Beneath Apple ProDOS". Briefly, the firmware entry point will be $Csxx, where s is the slot number and xx is the contents of $CsFF in the firmware. Below is a subroutine which will jump into the ProDOS firmware entry point. It assumes locations $0042-0047 have been properly set up for a call to the ProDOS firmware.

```
CALL.FIRMWARE           GET SLOT *16
      LDA  $43
      LSR
      LSR
      LSR
      LSR
                        hi-byte = $Cslot
      STA $01
      LDY#0
      STY $00           b-byte = $00
      DEY               Y=$FF
      LDA ($00),Y       Contents of $CsFF
      STA $00           $00,0l is entry point
      JMP ($00)
```

To read the status, you have to set up two page zero locations and call the firmware entry point; the size of the partition will be returned in the X- and Y-registers. The following code sets up the proper parameters for reading status and then uses the CALL.FIRMWARE subroutine above to call the ProDOS firmware on the RamFactor card. The example assumes the card is in slot 4:

```
      LDA #0                command code 0=
status
      STA  $42
      WA   #$40             slot# of RamFactor * 16
      STA  $43
      JSR  CALL.FIRMWARE
      STY  BLOCKS HI        # BLOCKS (HI-BYTE)
      STX  BLOCKS.LO # BLOCKS (LO-BYTE)
```

Another method for determining the size of the current partition is to examine the “screen-hole data after the card has been accessed. The ‘screen-holes” are locations Apple has reserved for use by the firmware for each slot. There are 8 locations reserved for each slot:

$478+slot	$4F8+slot
$578+slot	$5F8±slot
$678+slot	$6F8+slot
$778+slot	$7F8±slot

RamFactor puts the current data for the partition size in two of the screen holes:

$678+slot: # pages (hi-byte)

$6F8+slot: # pages (10-byte)

The number of pages divided by two is the number of blocks.

Another screen hole is set up with the size of the entire card. Location $478+slot holds the number of blocks divided by *256* of the entire card. Thus a value of 2 indicates there are 512 blocks, or 256K bytes.

The screen holes are only valid after accessing a partition. The meaning of the other screen holes is as follows:

$4F8+slot: index to partition data
$578+slot: partition base address (hi-byte)
$5F8+slot: partition base address (mid-byte)
$778+slot: operating system code
$7F8+slot: operating system check code

The information on card size and partition size is also stored in the RamFactor memory. Addresses 000000 through 0000FF are used for this purpose. Valid data in the first four bytes indicates the RamFactor memory has been partitioned. The first eight bytes are used for general information. The next nine groups of 24 bytes each are used to describe the partitions.

00: $AE
01: $F4
02: partition index (24 * part# 16)
03: partition index EOR $5A check code
04: # blocks / 256 in entire card
05-07: <<<reserved>>>
08-1F: partition 1 data
20-37: partition 2 data

C8-DF partition 9 data
E0-FF <<<reserved>>>

The partition data is laid out like this within each group of 24 bytes:

Relative 00: base address (hi)
01: base address (mid)
02: size (hi)
03: size (mid)
04: operating system code
05*:* operating system check code
06-07: <<<reserved>>>
08-17: name of partition

Protocol Converter

Description of the Protocol Converter

The Protocol Converter is a set of assembly language routines which turn the //c disk port into a multi-drop peripheral bus capable of supporting up to 127 external I/O devices. The firmware in the Apple Memory Expansion Card and RamFactor provide all the features of the protocol converter for one 110 device, the memory card itself. The interface card for using the UniDisk 3.5 in an Apple //e also supports a Protocol Converter.

Apple warns against using the Protocol Converter and states, ‘using the assembly-language protocol is fairly complicated.” Nevertheless, a significant amount of the Apple firmware is used to implement the Protocol Converter features. With this in mind let us proceed.

Using the Protocol Converter

In order to use the Protocol Converter firmware, you need first to find it. The first step in finding it is to find which slot it is in. Cards with Protocol Converter firmware can be identified by four bytes: $Cs0l = $20, $Cs03 $00, $Cs05 = $03, and $Cs07 = $00. The first three bytes in that list are the same for all disk drive controllers. The zero value at $Cs07 distinguishes it as a disk controller PLUS a Protocol Converter.

The next step is to find the entry point in the firmware for Protocol Converter calls. The byte a $CsFF is the key. That byte is the offset in the firmware page for ProDOS calls. If $CsFF = $45, for example, ProDOS device driver calls should take the form “JSR $Cs45”. To get the address of the Protocol Converter entry point, add 3 to the ProDOS entry point. In this example, “JSR $Cs48” would enter the Protocol Converter firmware.

A program to find the slot and build the address of the Protocol Converter could look like this:

```
pcaddr .eq $O1,$02
find.pc
            lda#O
            sta  pcaddr
            ldx  #$C7          slot = 7 to 1 step -1
.1          stx  pcaddr+1
            idy  #7
.2          ida  (pcaddr),y
            cmp                pc.slg,y
            beq  .3
            dex
            cpx                #$cl
            bcs  .1            try next slot
            sec                signal could not find pc
            rts
.3          dey
            dey
            bpl .2
            ida (pcaddr),y     $CsFF
            dc
            adc #3
            sta pcaddr
            rts                carry clear signals pc found

pc.sig .HS FF.20.FF.00.FF.03.FF.00
```

Once you have the address of the Protocol Converter firmware, you can call it in a manner similar to ProDOS MLI calls. You must plug the address of the Protocol Converter firmware into a “JSR” instruction, which is immediately followed by a one-byte command and a two-byte address.

The command number is a number from $00 to $09 which specifies which action you want the Protocol Converter to take.

The address is the address of a parameter block, which provides additional information for processing the command, or a place for the information returned by the command.

After the Protocol Converter has finished processing your command, it returns control to the next byte after the pointer to the parameter block. If carry is clear, there was no error. If carry is set, the A-register contains an error code.

Since the FIND.PC program left the address in two page zero locations, a JMP opcode ($4C) could be placed in front of the address to make it into a JMP instruction. Then our calls to the Protocol Converter would look like this:

```
callpc      .eq   $00          (just before pcaddr)
            jsr    find.pc
            bcs   ...           . ..no pc found
            lda   #$4C JMP opcode sta callpc
                    .other code
            jsr    callpc
            .da   #cmd,parameters
            ...    ...more code
```

Apple warns programmers NOT to use any page zero locations when calling the Protocol Converter firmware, saying that some page zero locations are used by that firmware. They do not say which locations they use, but investigations show that they use bytes in the range from $40 to $4F. What they do with those is push them on the stack, put their own data in them, and at the end restore the original contents from the stack. They use a substantial amount of stack, as many as 35 bytes. (The RamFactor firmware uses no more than 17 bytes of stack for Protocol Converter calls, including the two used by your JSR.) It is recommended that you can copy the PCADDR bytes up into your own program. You could even plug them in to every JSR to the Protocol Converter. For example:

```
            jsr    find.pc
            bcs   ...          ... no pc found
            lda    pcaddr
            sta    callp+l
            lda    pcaddr-'-1
            sta    callpc+2

            jsr   callpc
            .da   #cmd,parameters
            ...
callpc      jmp    * address filled in
```

Description of Protocol Converter Commands

Apple defines ten commands for the Protocol Converter firmware. These are not necessarily identical in function for all devices which use the Protocol Converter. In fact, Apple's memory card uses two of the commands in a different way than Apple's UniDisk 3.5 does. The Protocol Converter firmware in the RamFactor functions exactly the same way as that in the Apple Memory Expansion Card.

The following chart summarizes the ten commands as implemented in the RamFactor firmware.

Parameters:	+0	+1	+2	+3	+4	+5	+6	+7	+8
	cnxl	cnt	unit						
PC Status	$00	3	0	buf-lo	buf-hi	code			
RAM Status	$00	3	1	buf-lo	buf-hi	code			
Read Block	$01	3	1	buf-lo	buf-hi	bik-lo	bik-mi	blk-hi	
Write Block	$02	3	1	buf-lo	buf-hi	bllc-lo	bik-mi	bik-hi	
Format	$03	1	1						
Control	$04	3	0/1	buf-lo	buf-hi	code			
Init	$05	1	0/1						
Read Bytes	$08	4	1	buf-lo	buf-hi	cnt-lo	cnt-hi	adr-lo	adr-mi	adr-hi
Write Bytes	$09	4	1	buf-lo	buf-hi	cnt-lo	cnt-hi	adr-lo	adr-mi	adr-hi

Error Codes	$01	Command not $00-$05,$08, or $09
	$04	Wrong parameter count
	$11	Invalid Unit Number
	$21	Invalid Status or Control code
	$2D	Block Number too large

- **PC Status (cmd $00, unit $00, code $00):** reads the status of the Protocol Converter itself into your buffer. The status of the RamFactor is always 8 bytes, with the first byte = $01 and all the others = $00. Also returns with $08 in the X-register and $00 in the Y-register. This is of no value except for compatibility with other devices supporting Protocol Converter firmware.

- **RAM Status (cmd $00, unit $01, code $00 or $03):** reads the status of the RamFactor card into your buffer. Code $00 will cause four bytes to be stored: the first is always $F8, and the other three are the number of blocks in the current partition (10, mid, hi order). (Y,X) will equal ($00,$04) when it is finished. Code $03 will cause 25 bytes to be stored: the first four are the same as code $00 returned; the next 17 are the name of the card in "ProDOS Volume Name" format (length of name in first byte, ASCII characters of name with hi-bit off, padded with blanks); and finally, four zero bytes. The card name is "RAMCARD". (Y,X) will return ($00,$ 19) when finished. These responses are identical to the response given by Apple's Memory Expansion Card, for compatibility reasons.

- **Read Block (cmd $01):** reads the specified block from the current RamFactor partition into your buffer. You can read a block into a buffer in //e Auxiliary Memory by calling the Protocol Converter with the RAMWRT soft-switch set to AuxMem.

- **Write Block (cmd $02):** writes the specified block from your buffer into the current RamFactor partition. If you are careful and follow all the rules, you can write a block from a buffer in //e Auxiliary Memory by calling the Protocol Converter with the RAMRD soft-switch set to AuxMem. You have to put the code that sets the RAMRD switch and calls the Protocol Converter, along with its parameter block, into page zero or one of motherboard RAM ($OO00-O1FF), or in the language card RAM area. Or, you can have both RAMRD and RAMWRT set for AuxMem and be executing a program from within AuxMem.

- Format **(cmd $03):** does nothing in a RamFactor card.

- **Control (cmd $04):** does nothing in a RamFactor card. If the code is not $00, you will get error code $21. The buffer is never accessed.

- **Init (cmd $05***):* does nothing in a RamFactor card.

- **Open or Close (cmd $06 or $07):** cause error code $01 in a RamFactor card. These commands only apply to character-oriented devices, and RamFactor is a block-oriented device (so says Apple).

- **Read Bytes (cmd $08)**: reads a specified number of bytes starting at a specified RamFactor address into your buffer. The byte count may be as high as $FFFF, but this would obviously wreak havoc inside your Apple. No checks are made inside the protocol firmware for reasonableness of the buffer address or the byte count, so be careful. The RamFactor address may be as high as $7FFFFF. This corresponds to a total of 8 megabytes, which is only half the maximum capacity of a RamFactor card. Apple has arbitrarily limited us to this maximum, because they use the top bit of the card address to specify whether the buffer is in MainMem (bit 23 =0) or AuxMem (bit 23 = 1). (Bit 23 of the address is bit 7 of the last byte of the parameter block.)

- **Write Bytes (cmd $09**): writes a specified number of bytes from your buffer starting at a specified RamFactor address. The details of byte count, buffer location, and RamFactor address are the same as for the Read Bytes ($08) command.

A: *RamCharger —RamFactor Battery Backup Option*

You have by now, no doubt, witnessed the impressive speed of the RamFactor card when used as a RAMdisk. Remember that one of the major disadvantages of a RAMdisk is its volatility. Even a brief power interruption will completely erase the contents of a RAMdisk. The RamCharger Battery Backup Option eliminates this disadvantage and turns the RamFactor into a non-volatile, bootable storage device. Not only does the RamCharger protect the contents of RamFactors memory during momentary power outages, it provides extended protection against loss of data during long power failures.

RamCharger installation is simple. Plug the AC power cord into any grounded 120 volt wall socket (240v model available) and connect the RamFactor power cable to the RamFactor's power socket.

The RamCharger battery and charger are entirely contained within an attractive case similar to the Disk II case. During normal operation, RamCharger charges its internal battery and supplies power to the RamFactor memory chips. When the AC power to RamCharger is interrupted, RamCharger instantly switches to battery power until the AC power is restored. RamCharger's heavy duty battery can maintain memory on a 1 megabyte RamFactor for over *5* hours. AC power will maintain RamFactor memory indefinitely!

Attention IIGS and Enhanced //e Users: One of the features of the Apple IIGS and Enhanced Apple //e enables it to boot from a RamFactor card. When you turn the computer on, you can automatically boot into your favorite program in the wink of a eye.

In a //e, if the RamFactor card is installed in a slot numerically higher than the first disk drive interface card (i.e. slot 7), the active bootable partition can be booted just like a conventional disk drive.

In a IIGS, you can boot from the RamFactor in any slot (except 3) by setting your startup slot in the Control Panel Menu. (See your *Apple IIGS Owner's Guide* for details.)

B: *RamFactor Memory Test*

There are actually two different tests included with your RamFactor. Use either RamFactor Memory Test to verify the basic operation and hardware reliability of the RamFactor card. If you encounter problems when running a program that you feel relate to RamFactor memory, these tests are a good first step in diagnosing the problem.

DO NOT attempt to repair your RamFactor card! It could void your warranty.

Test on AW 2 Expander disk: One test is included on the AW 2 Expander disk. To run this test program, turn the computer off, insert the AW 2 disk or the AW 2 Expander disk in your startup drive, and turn the computer on. When the main menu appears, select the "RamFactor Memory Test" option. Select the appropriate option from the memory-test options menu. If you hold the Open Apple key down momentarily while you select the memory test, it will execute a longer more thorough memory test.

A graphic representation of the product being tested will appear on the screen. The test indicates any defective RAM chips or empty RAM sockets with a "xx" in the corresponding chip location on the graphic display. After eight successful passes, the program displays the message "Card Passed," indicating that the circuitry on the card has passed. In the lower left corner of the screen, a "pass indicator" will show how many times the program has run the memory test. The program will repeat the memory test indefinitely. Press any key to terminate the RAM test and enter the 80 column and high-resolution display portion of the RamWorks test.

Test in firmware: The other test is contained in the RamFactor's firmware. To run this test, while in BASIC, type call -151. Then type, *"Cs0AG"* where *s* is equal to the slot containing your RamFactor. To stop this test, press Control-Reset.

If the test passes and you still experience problems with your program, the next step will be to eliminate the software as a possible source of the problem. Try to run different software packages or another copy of the program you are having problems with. Our experience shows that a large majority of "program crashes" are not necessarily caused by hardware failures but by software problems. Many software publishers offer technical support for software related problems.

If the RamFactor Memory Test fails, turn the system off, insure that all of the socketed memory chips and connectors are correctly and securely seated. (Often, just reseating the chips and connectors has a magical healing effect on a sick computer!) Turn the system on and run the memory test again. If it still fails, refer to the Technical Support section in this manual.

C: *Copying Disks with Filer*

We have included Filer, a utility program, on the AW 2 Expander disk to enable you to make backup copies of your disks that are not copy protected. The instruction below tell you how to use Filer to copy from disk to disk. See Chapter 2 for instructions on using Filer to copy AppleWorks to your RamFactor.

1. Load Filer.

2. Select "Volume Commands" (v).

3. Select "Copy a Volume" (C). The settings default to a two drive set up with your master in Slot 6 Drive 1 and your copy disk in Slot 6, Drive 1. Adjust to your set up. (If you only have one drive you can copy from S6, D1 to S6, D1.)

4. Press return to accept the default settings or enter your own.

5. Insert the master disk in your drive that you have set the program to copy from. Insert a blank disk (it does not need to be formatted) in the drive you have set the program to copy to. The blank disk must have the write protect tabs removed.

6. Press the Return key.

7. Name your volume. It will default to the name of the master disk (ex: When copying AppleWorks, the volume name will default to "/APPLEWORKS"). Hit return or give it a different name.

8. When you press return, the copy program will begin formatting the copy disk. Then the words "READING" and "WRITING" will flash on and off the screen to entertain you while you wait.

9. When the program is finished copying AppleWorks, it sends the message, "COPY COMPLETE" to the screen.

10. Remove both disks. Put your master disk in a safe place and label your copy disk. You will make your modifications to the copy disk.

For additional help with the Filer program, contact your Apple dealer.